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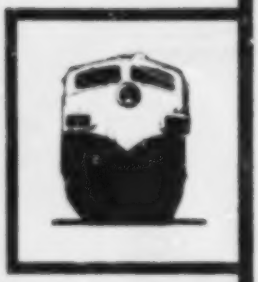

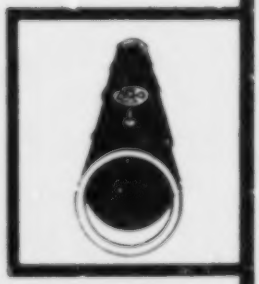

PB86-916303

# NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

## RAILROAD ACCIDENT REPORT

HEAD-ON COLLISION OF
BURLINGTON NORTHERN
RAILROAD COMPANY FREIGHT TRAINS
EXTRA 6311 WEST AND
EXTRA 6575 EAST
NEAR WESTMINSTER, COLORADO
AUGUST 2, 1985

ORIGINAL

NTSB/RAR-86/02

UNITED STATES GOVERNMENT

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TECHNICAL REPORT DOCUMENTATION PAGE

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16. Abstract

About 7:40 p.m. on August 2, 1985, Burlington Northern Railroad Company mixed freight train Extra 6311 West collided head-on with Burlington Northern Railroad Company unit gravel train Extra 6575 East at milepost 12.5, near Westminster, Colorado. Extra 6311 West was traveling about 52 mph, and Extra 6575 East was traveling about 48 mph. The trains collided on the single main track during daylight hours in a 2° 41' left curve in a westerly direction about 50 feet west of a dual-lane bridge on U. S. Highway No. 36. The bridge was destroyed by derailed cars which struck structural support members and by fire which erupted following the collision. Three crewmembers of Extra 6311 West and two crewmembers of Extra 6575 East were killed. The Burlington Northern Railroad Company estimated the damage to be about $4 million.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of a crewmember of Extra 6311 West to read the train register information correctly at Clear Creek, Colorado, and the failure of the conductor to correlate that information with the train orders, which caused Extra 6311 West to depart Clear Creek before the arrival of Extra 6575 East, a superior train. Contributing to the severity of the accident was the overspeed of Extra 6575 East.

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

RAILROAD ACCIDENT REPORT

**Adopted: June 20, 1986**

# HEAD-ON COLLISION OF BURLINGTON NORTHERN RAILROAD COMPANY TRAINS EXTRA 6311 WEST AND EXTRA 6575 EAST NEAR WESTMINSTER, COLORADO, AUGUST 2, 1985

## SYNOPSIS

About 7:40 p.m. on August 2, 1985, Burlington Northern Railroad Company mixed freight train Extra 6311 West collided head-on with Burlington Northern Railroad Company unit gravel train Extra 6575 East at milepost 12.5, near Westminster, Colorado. Extra 6311 West was traveling about 52 mph, and Extra 6575 East was traveling about 48 mph. The trains collided on the single main track during daylight hours in a 2° 41' left curve in a westerly direction about 50 feet west of a dual-lane bridge on U. S. Highway No. 36. The bridge was destroyed by derailed cars which struck structural support members and by fire which erupted following the collision. Three crewmembers of Extra 6311 West and two crewmembers of Extra 6575 East were killed. The Burlington Northern Railroad Company estimated the damage to be about $4 million.

The National Transportation Safety Board determines that the probable cause of the accident was the failure of a crewmember of Extra 6311 West to read the train register information correctly at Clear Creek, Colorado, and the failure of the conductor to correlate that information with the train orders, which caused Extra 6311 West to depart Clear Creek before the arrival of Extra 6575 East, a superior train. Contributing to the severity of the accident was the overspeed of Extra 6575 East.

## INVESTIGATION

### The Accident

On August 1, 1985, Cheyenne, Wyoming, was subjected to a torrential rain and hail storm. As a result of flood conditions at Cheyenne, the Burlington Northern Railroad Company (BN) lost most of its telephone and radio communication facilities between the Colorado Division, Third Subdivision of the Denver Region and the train dispatcher at McCook, Nebraska. Mobile point-to-point radio communications were not affected by the flood.

On August 2, trains on the Third Subdivision that ordinarily would have been operated over a longer time span were ready to be moved one behind the other because of delays resulting from the flood damage to the communication facilities at Cheyenne and because of track work being done on the Third Subdivision between Denver, Colorado, and Longmont, Colorado. The traffic movement on the Third Subdivision, which seemed to culminate about 3 p.m., and the disrupted communication facilities caused the 3 p.m. to 11 p.m. train dispatcher at McCook to be busier than usual coordinating an increased number of train movements, especially in the Cheyenne area. Normally, six to eight trains move over the Third Subdivision during an 8-hour period.

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Extra 6575 East.--Extra 6575 East, a unit gravel train 1/ operating between Longmont and Clear Creek, Colorado, was scheduled to leave Longmont at 2 p.m. (See figure 1.) Because there were no car inspectors located at Longmont, the three-man crew, consisting of the engineer, the conductor, and the brakeman, inspected the train and made a brake test, as required by Federal regulations. The inspection and brake test were completed at 3:15 p.m., and no exceptions were taken to the brakes or the mechanical condition of the equipment.

Following the inspection and brake tests, Extra 6575 East was required to wait at Longmont for two westbound trains and for the necessary train orders authorizing the gravel train to leave Longmont. At 5:07 p.m., the dispatcher issued train order No. 28 through the operator at Longmont to the conductor and engineer (C&E) of Extra 6575 East (see appendix C) and simultaneously issued the same order to the C&E of Extra 6311 West at the 31st Street Yard in Denver. Train order No. 28 stated:

> Extra 6575 East has right over Extra 6311 West Longmont to Clear Creek. Extra 6575 East register at Clear Creek on order No. 28 of Aug 2. Extra 6311 West may check register at Clear Creek against Extra 6575 East on order No. 28 of Aug 2.
>
> (signed) JWH

At 6:13 p.m., the dispatcher issued train order No. 44 through the operator at Longmont to the C&E of engine 6575. Order No. 44 authorized engine 6575 to be operated as Extra 6575 East from Longmont to Clear Creek and to return to Longmont as Extra 6575 West. (See appendix C.) At 6:15 p.m., the dispatcher authorized the operator at Longmont to clear 2/ Extra 6575 East with six orders which included train order Nos. 28 and 44. (See appendix C.)

Extra 6575 East departed Longmont at 6:30 p.m. consisting of two locomotive units, 31 loaded hopper cars, and a caboose, for a total of 4,089 tons. The engineer and the brakeman were on the lead locomotive unit, BN 6575, and the conductor was on the caboose.

The conductor of Extra 6575 East testified that the trip between Longmont (milepost (MP) 43.6) and MP 12.5 was made without any unusual occurrences. He said that the engineer reduced the speed of the train to 10 mph between MP 17 and MP 16.5 in compliance with a train order speed restriction and that he took no exceptions to the manner in which the engineer handled the train.

When the train was near Broomfield, Colorado (MP 14), the conductor moved to the right side of the cupola in the caboose to observe the train as it moved around a right-hand curve near Broomfield. He said that he took no exceptions to the train's condition or to the manner in which the engineer was handling the train. He remained on the right side of the cupola until the train approached a curve at MP 12.5 so he could inspect the train as it moved around the curve. (See figure 2.) The conductor said that as the train was moving through the curve, he suddenly saw the headlight of a westbound locomotive emerge from under the highway bridge, and knowing the trains were going to collide, he braced himself.

---

1/ Geographically, trains are operated north and south. Timetable direction is east (south) and west (north). Timetable directions will be used in this report.

2/ A check between the train order operator and the dispatcher to insure that the train concerned receives all intended messages and train orders.

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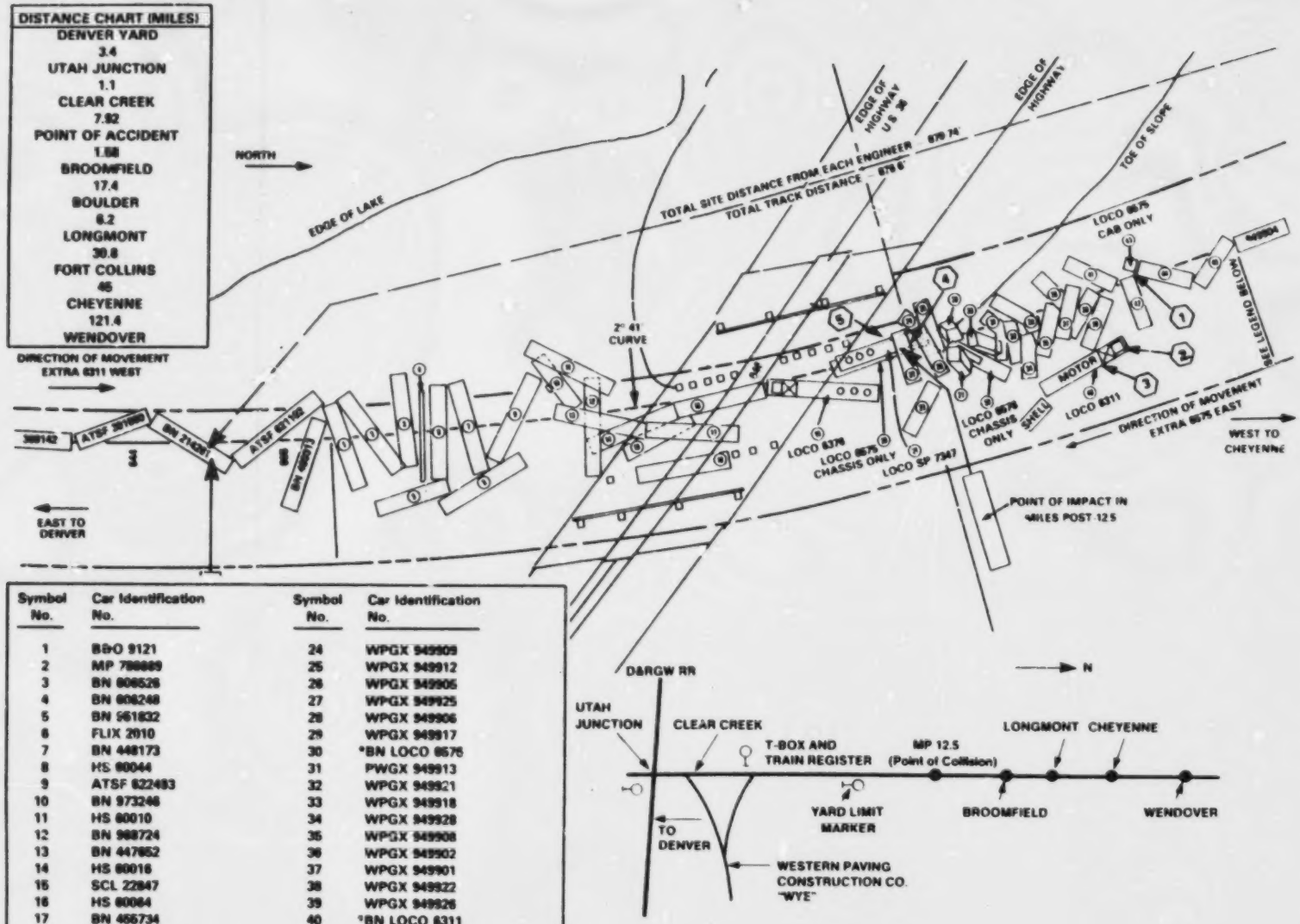


| Symbol No. | Car Identification No. | Symbol No. | Car Identification No. |
|---|---|---|---|
| 1 | B&O 9121 | 24 | WPGX 949909 |
| 2 | MP 786689 | 25 | WPGX 949912 |
| 3 | BN 606526 | 26 | WPGX 949905 |
| 4 | BN 606248 | 27 | WPGX 949925 |
| 5 | BN 561832 | 28 | WPGX 949906 |
| 6 | FLIX 2010 | 29 | WPGX 949917 |
| 7 | BN 448173 | 30 | *BN LOCO 6576 |
| 8 | HS 60044 | 31 | PWGX 949913 |
| 9 | ATSF 622483 | 32 | WPGX 949921 |
| 10 | BN 973246 | 33 | WPGX 949918 |
| 11 | HS 60010 | 34 | WPGX 949928 |
| 12 | BN 968724 | 35 | WPGX 949908 |
| 13 | BN 447852 | 36 | WPGX 949902 |
| 14 | HS 60016 | 37 | WPGX 949901 |
| 15 | SCL 22847 | 38 | WPGX 949922 |
| 16 | HS 60064 | 39 | WPGX 949926 |
| 17 | BN 456734 | 40 | *BN LOCO 6311 |
| 18 | HS 60044 | 41 | WPGX 949931 |
| 19 | *LOCO 6376 | 42 | WPGX 949929 |
| 20 | *LOCO 6575 CHASSIS ONLY | 43 | *BN LOCO 6575 CAB ONLY |
| 21 | *LOCO SP 7347 | 44 | WPGX 949924 |
| 22 | WPGX 949919 | 45 | WPGX 949903 |
| 23 | WPGX 949907 | | |

Figure 1.--Plan view of derailment.





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Figure 2.--Approach view eastbound of curve at MP 12.5 for Extra 6575 East.

Extra 6311 West.--Extra 6311 West was called to depart Denver Yard at 5 p.m. However, the train was delayed because of switching cars and conduction of the Federally required airbrake tests and inspection. The Federally required brake test and train inspection was completed, and no exceptions were taken to the train's mechanical condition. Extra 6311 West was further delayed because of the train dispatcher's inability to issue the necessary train orders at that time as a result of a heavy work load.

At 5:05 p.m., the train dispatcher at McCook issued train order No. 28 through the train order operator at the BN's 31st Street Yard in Denver to the C&E of Extra 6311 West at Denver. At 6:24 p.m., the train dispatcher issued train order No. 47 to the C&E of engine 6311 through the train order operator at the 31st Street Yard. (See appendix D.) Train order No. 47 authorized engine 6311 to be operated as Extra 6311 West between Utah Junction, a terminal location in Denver, and Cheyenne.

At 6:27 p.m., the train dispatcher authorized the train order operator at the 31st Street Yard to clear Extra 6311 West with six train orders which included train orders Nos. 28 and 47. (See appendix D.) The conductor testified that when he received the train orders, he delivered a copy to the engineer. He said that, however, he did not discuss the orders with either the engineer or the two brakemen because "they were in a hurry to get us out," meaning the yard supervisors wanted Extra 6311 West to leave.

Extra 6311 West departed the 31st Street Yard at 6:41 p.m. and consisted of three locomotive units, 23 loaded and 27 empty cars, and a caboose, for a total load of 2,862 tons. The engineer, the head brakeman, and the rear brakeman were on the locomotive, and the conductor was on the caboose. The rear brakeman had volunteered to ride the locomotive to assist the head brakeman with switching work to be done at several stations en route to Cheyenne.

As Extra 6311 West was leaving the yard, the engineer radioed the BN Centralized Traffic Control (CTC) operator at the 31st Street Yard and requested that the operator ask the Denver, Rio Grande and Western Railroad (D&RGW) dispatcher to display a permissive signal at Utah Junction for Extra 6311 West. (The BN and the D&RGW cross at grade at Utah Junction and the D&RGW dispatcher controls the home signals.) 3/ The conductor broke in at the end of the engineer's transmission to remind the engineer to check the train register at Clear Creek; the conductor said that the engineer acknowledged the conductor's message.

Extra 6311 West proceeded 4.5 miles to Clear Creek, where it stopped about 7 p.m. with the locomotive standing opposite the train register location so that a crewmember could check the train register for the arrival of superior train Extra 6575 East in accordance with train order No. 28. Extra 6311 West could not have been operated past the train register location because that would have violated the trackage rights given to Extra 6575 East by train order No. 28. (See appendix C.)

Shortly afterward, the conductor received a radio call from an unidentified voice on the locomotive. According to a tape monitor recording of the dispatcher's radio circuit made through the radio base station at Longmont, the caller merely said "4:40 Howard." 4/ After a brief 3- to 4-second delay a response came, "440," and the voice trailed off so the balance of the response was unintelligible. The crewmember who

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3/ A roadway signal at the entrance to a route or block to govern trains in entering and using that route or block.

4/ 4:40 refers to the time. Howard was the first name of the conductor of Extra 6311 West.

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examined the train register did not sign or initial the pertinent page of the register book. (In an early postaccident interview conducted by BN officers, the conductor of Extra 6311 West said he thought it was the rear brakeman who radioed him the train register information, but later he said he was not sure who had called on the radio.) The conductor said that the call indicated to him that Extra 6575 East, identified in train order No. 28, had arrived at 4:40 p.m and that, based on the information, he authorized the engineer of Extra 6311 West to depart Clear Creek and to proceed westward. (See appendix E.) The stop at Clear Creek by Extra 6311 West was verified by the conductor and by an eyewitness on the property of the Western Paving Construction Company located at Clear Creek.

Extra 6311 West departed Clear Creek about 7:10 p.m., and proceeded westward to 92nd Street, near MP 10, where it stopped to set off a car. The train departed about 7:30 p.m., and continued toward Cheyenne. The engineer and the head brakeman were in the operating compartment of locomotive unit 6311, and the rear brakeman was in the operating compartment of the second locomotive unit, Southern Pacific (SP) 7374.

About 7:40 p.m., the train emerged from beneath a dual-lane bridge on U.S. Highway 36, the Boulder Turnpike, near MP 12.5. Extra 6311 West, which was traveling about 52 mph, collided head-on with Extra 6575 East, which was traveling about 48 mph. (See figure 3.)

The three locomotive units of Extra 6311 West and the two locomotive units of Extra 6575 East enmeshed and fire ensued from the diesel oil spilled from ruptured fuel tanks. Twenty-two cars of Extra 6311 West and 21 cars of Extra 6575 East derailed and piled upon and around the locomotives. (See figures 4 and 5.) The engineer and the brakeman of Extra 6575 East and the engineer, the head brakeman, and the rear brakeman of Extra 6311 West were killed; and the conductor of Extra 6311 West received minor injuries.

The conductor of Extra 6311 West attempted to contact by radio the CTC operator at the 31st Street Yard to notify him of the circumstances of the accident, but he was unsuccessful because radio channel 1 was being used by BN personnel in the Denver area. However, a BN clerk at Golden, Colorado, answered the conductor's emergency radio transmission and relayed the collision information to the CTC operator at the 31st Street Yard. The CTC operator notified the train dispatcher at McCook and local emergency forces.

**Injuries to Persons**

| Injuries | Extra 6575 East | Extra 6311 West | Total |
|---|---|---|---|
| Fatal | 2 | 3 | 5 |
| Injured | 0 | 1 | 1 |
| None | 1 | 0 | 1 |
| Total | 3 | 4 | 7 |

**Damage**

The three locomotive units of Extra 6311 West and the two locomotive units of Extra 6575 East were destroyed because of structural damage from the collision and the ensuing fire. Also 38 freight cars were destroyed. The impact forces of the derailing/piling cars against the highway bridge support members and the heat from the fire caused the bridge to buckle and distort to partial destruction so that it had to be torn out and rebuilt. (See figures 4 and 5.) About 900 feet of the main track were destroyed.

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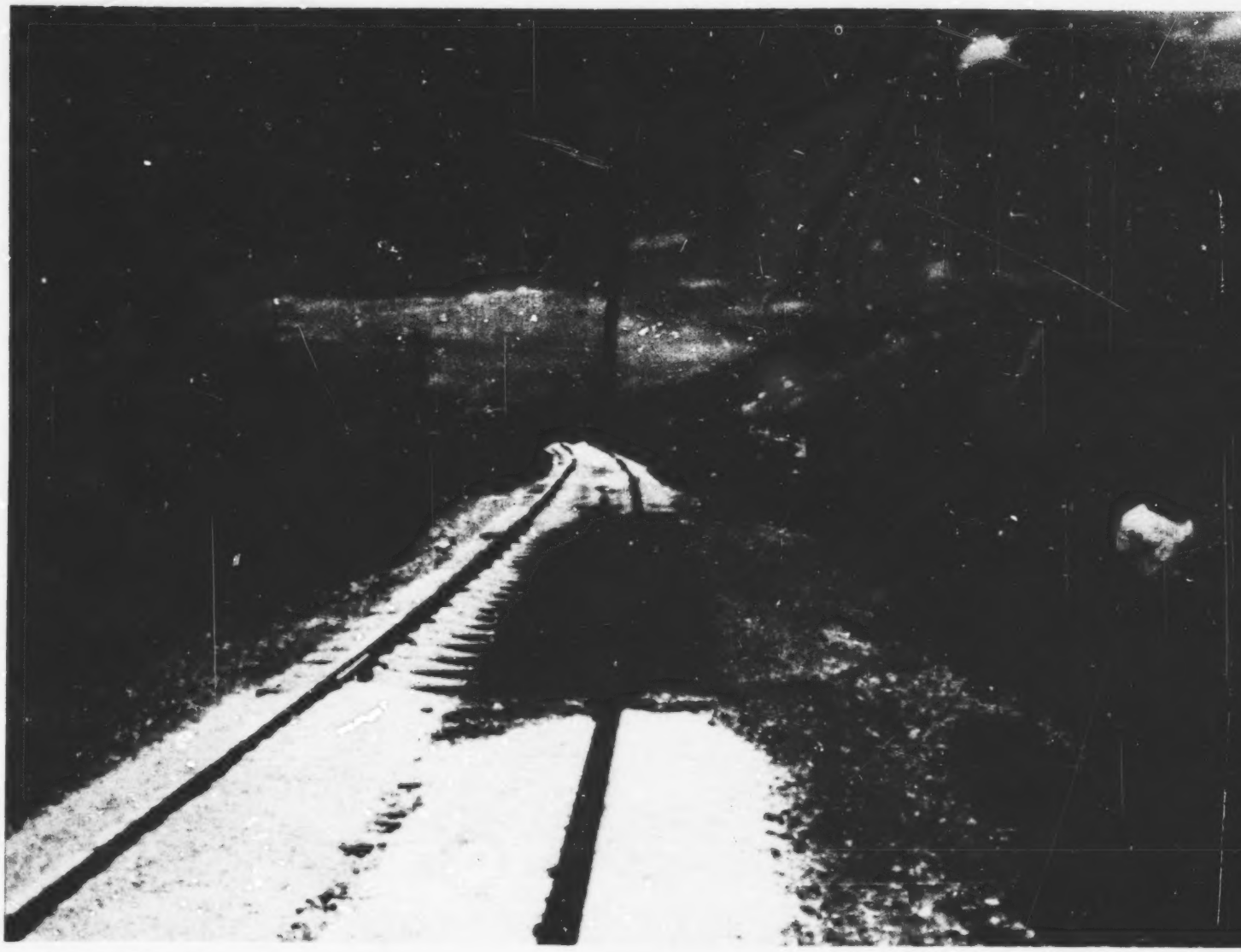

Figure 3.--Approach view to curve at MP 12.5 for Extra 6311 West.



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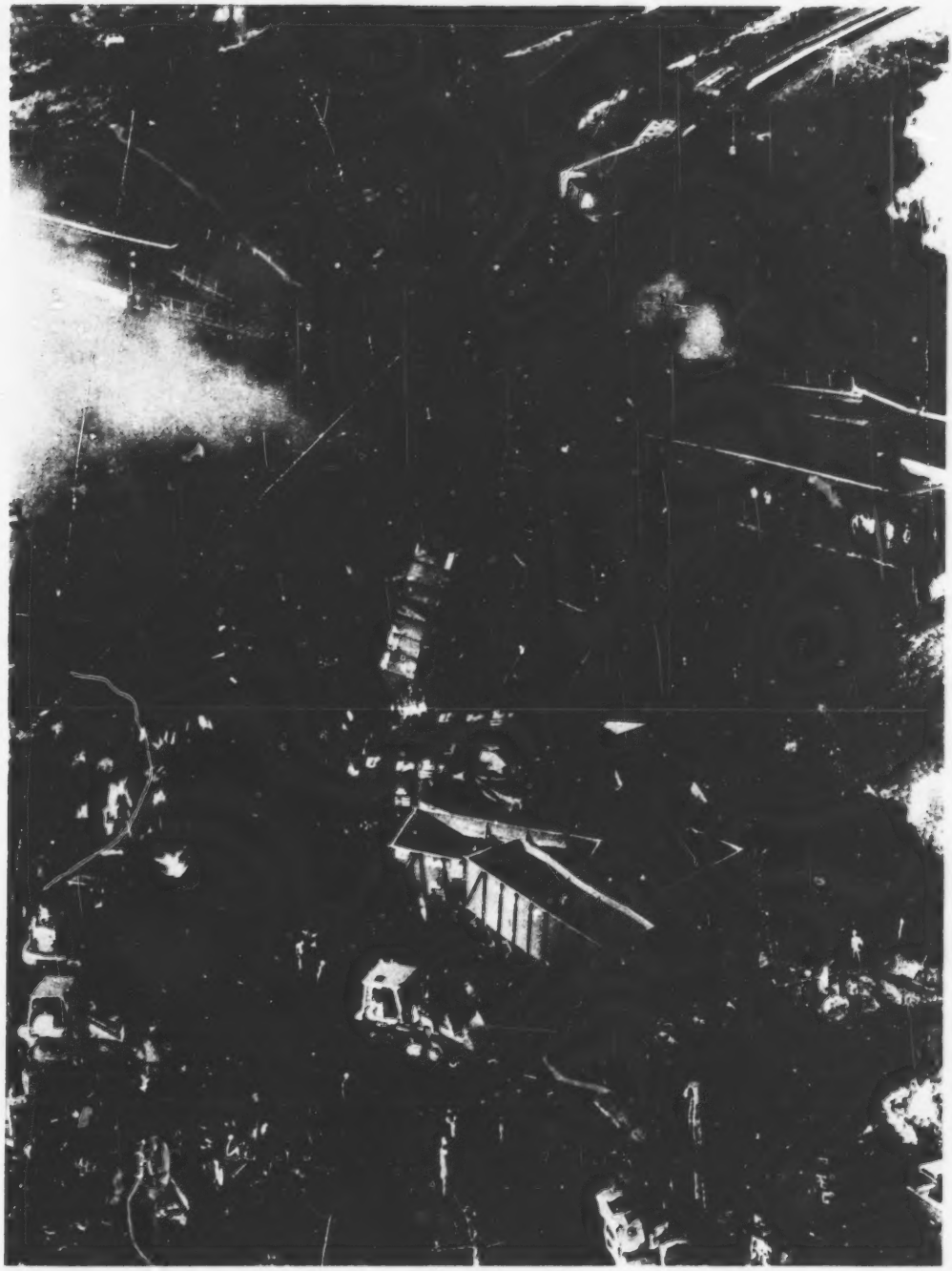

Figure 4.--Wreckage looking east.

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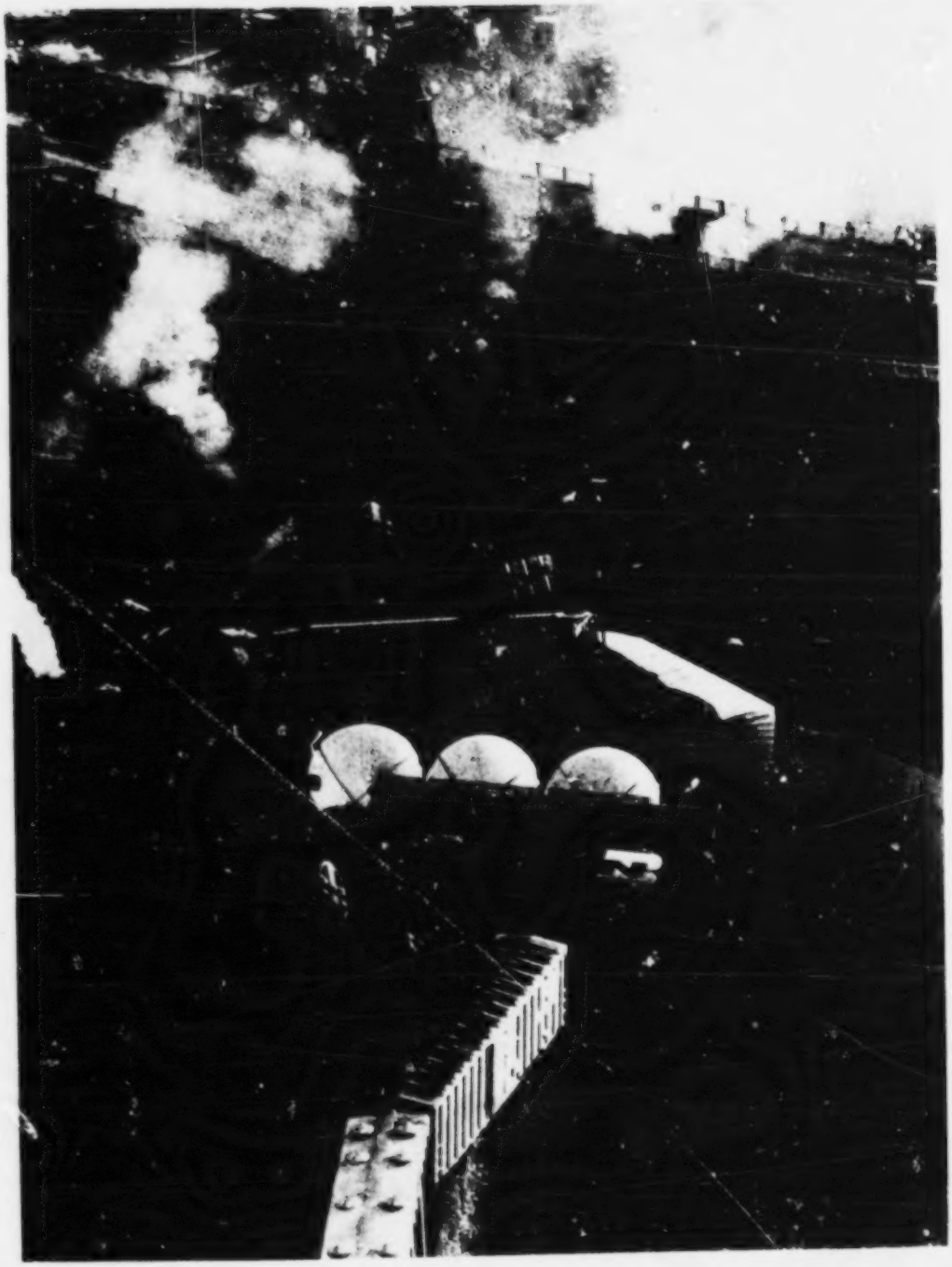

Figure 5.--Wreckage looking west.

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The BN estimated the damage to be:

| Item | Damage | |
|---|---|---|
| Locomotive Extra 6575 East | $ 281,121 | |
| Car Equipment | 748,000 | |
| Sub-Total | | $1,029,121 |
| Locomotive Extra 6311 West | 1,094,095 | |
| Car Equipment | 382,600 | |
| Sub-Total | | 1,476,695 |
| Track | 24,000 | |
| Bridge | 1,500,000 | |
| Sub-Total | | 1,524,000 |
| Total | | $4,029,816 |

The $4,029,816 damage value does not include the total cost of the accident. There is no allowance for the loss of revenue, the cost of detouring trains, litigation, and other associated expenses.

**Dispatcher and Crewmember Information**

The train dispatcher and the crewmembers of each train were qualified for their respective positions according to the BN operating rules and requirements. BN employees, who formerly were employed by the Colorado and Southern (C&S) Railroad, are given physical examinations once every 4 years before age 50 and annually after age 50. (See appendix B.) A re-examination on the operating rules is required biennually. At the time of the accident, the crew of Extra 6311 West had been on duty 2 hours 40 minutes, and the crew of Extra 6575 East had been on duty 5 hours 40 minutes.

Train Dispatcher.--The dispatcher was well rested when he reported for duty on August 2, after having been off duty 16 hours. He stated that he liked his work and that he was not concerned about any personal problems that would have distracted him from his duties.

Extra 6311 West.--None of the medical records of the four crewmembers of Extra 6311 West contained any information concerning uncorrectable difficulties involving vision, hearing perception, or other medical factors.

The engineer had been off duty 13 1/2 hours before reporting for duty at 5 p.m. on August 2. Friends of the engineer described him as a conscientious person, a good "railroader," and a "super" individual. He was reported to have liked his job and was looking forward to retirement.

The head brakeman had been off duty 13 hours 15 minutes when he reported for duty as the relief brakeman at 5 p.m. on August 2. He was considered "very mature, sincere and bright" by the BN supervisor who interviewed him and recommended that he be hired.

The rear brakeman had been off duty 25 hours 15 minutes when he reported for duty at 5 p.m. on August 2. He was described as a hard worker who "knew railroading well." One person who saw the rear brakeman on August 2 said that he appeared to be "preoccupied and that he was not exhibiting his normal outgoing talkative personality."

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The BN crew clerk said that when he called the crewmembers for Extra 6311 West, they all sounded well rested and that no one hesitated to accept the call, except the head brakeman who asked to be relieved for the day. The head brakeman's request was denied because of the short interval between the time of the call and the time the head brakeman was required to report for duty. The head brakeman agreed to accept the assignment without further comment. The crew clerk later speculated that the head brakeman requested to be relieved of the assignment because more severe weather was forecast for Cheyenne, which was his home. The crew clerk said that the engineer had played golf that day with two other BN employees.

Extra 6575 East.--The crew of Extra 6575 East reported for duty at Longmont at 2 p.m. on August 2, after having been off duty 17 hours. The conductor of Extra 6575 East said that the engineer was "very conscientious" and that both the head brakeman and the engineer were in "high spirits."

**Train Information**

Extra 6311 West consisted of 3 locomotive units, 23 loaded and 27 empty freight cars, and a caboose, for a total of 2,862 tons. Two of the locomotive units, BN 6311 and SP 7374, were type SD-40, built in 1971 and 1980, respectively, by the Electro Motive Division (EMD) of General Motors Corporation. The third locomotive unit, BN 6376, was type SD-40-2, built in 1974 by the EMD. All three units had six axles, and each was rated at 3,000 horsepower.

Extra 6575 East consisted of two locomotive units, 31 hopper cars which were owned by the Western Paving Construction Company, and a caboose, for a total of 4,089 tons. BN locomotive units 6575 and 6576 were type SD-45 built by the EMD division of General Motors Corporation in 1971. Both locomotive units had six axles and each was rated at 3,600 horsepower.

Locomotive units 6311 and 6575 were equipped with Barco speed recorders and two-way radios operable on road channel 1 (161.1 mhz) and yard channel 2 (161.16 mhz). Neither unit was provided with alerting devices or deadman control facilities.

The caboose of each train had permanently-mounted radios, and a portable radio was assigned to each conductor.

**Method of Operation**

General.--The dispatcher at McCook is assigned to a territory of 284.9 miles, which includes the 3rd Subdivision, which extends 237.5 miles from Denver to Wendover; the 11th Subdivision, which extends 7.7 miles from Broomfield to La Fayette, Colorado; the 12th Subdivision, which extends 10.3 miles from Longmont to Lyons; the 13th Subdivision, which extends 15.3 miles from Prospect Junction, near 31st Street Yard in Denver, to Golden, Colorado; and the 14th Subdivision, which extends 14.1 miles from Leadville, Colorado, to Climax, Colorado.

Trains are operated over the Third Subdivision by train orders, Superintendent's Bulletins, Timetable, and Special Instructions. The Third Subdivision is not equipped with automatic block signals. On August 2, the BN was using the Consolidated Code of Operating Rules (Operating Rules) as operating authority; the same rule book is used by about 16 other railroad companies. Beginning at 12:01 a.m. on April 27, 1986, the General Code of Operating Rules replaced the Consolidated Code of Operating Rules on the entire BN system. Also at 12:01 a.m. on April 27, 1986, the TWC system of train operation was

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placed into service on a number of subdivisions including the Third Subdivision, eliminating the use of train orders and intermediate train registers. The maximum authorized speed for freight trains is 49 mph, unless otherwise restricted.

Although BN locomotives and cabooses are equipped with radios, the BN does not require their use in train operations. An attempt is made by BN management to have operable radios on trains leaving a terminal, but it is not a requirement.

The train dispatcher at McCook directs the movement of trains on the Third Subdivision by train orders which are issued to the affected train(s) through train order operators located in offices at the 31st Street Yard, Longmont, and Fort Collins, Colorado, and at Cheyenne, Wheatland, and Wendover, Wyoming. None of the train order offices are open 24 hours per day. When the train operator offices are closed, the dispatcher may issue train orders by radio to the conductor or engineer of the train.

Train Orders.--BN operating rule 214 states, in part:

> Train orders must be read promptly upon receipt by those to whom they are addressed. Conductors must, when practicable, obtain from engineers an understanding of all train orders before they are acted upon. Conductors must, when practicable, show train orders to trainmen. Engineers must show train orders to members of the crew on the engine. All crewmembers are responsible for complying with the requirements of train orders and reminding each other of their contents.

Train Register.--Train register books are provided at initial and final terminals and at other locations specified in the timetable. The current timetable indicates that on the Third Subdivision, train registers are located at Clear Creek and Broomfield, Colorado, and at Platte River, Wheatland, and Moba, Wyoming. At initial and final terminals, information, such as the names of the conductor, the engineer, and the brakemen, the time they reported for duty, the locomotive unit numbers, the number of loaded and empty cars, and the train tonnage must be recorded in the train register. Operating Rule 83(A) states, in part:

> Unless otherwise provided, conductors of all trains, and engineers of trains without conductors, must register their trains on the train register at points designated in the timetable. . . . Conductors must fill out train register check on the prescribed form and deliver or have it delivered to engineer before leaving register station, unless check of trains is received by train order or entire movement will be within CTC or Rule 251 territory.

The BN rules examiner interpreted rule 83(A) to mean that conductors or engineers, when applicable, are required to fill out the train register only at initial and final terminals. The rule does not designate which crewmember shall check the train register at intermediate locations. When the conductor fills out the train register, he must complete the train register check form which is printed on the reverse side of the clearance card used by train order operators to clear a train with train orders for delivery to the engineer. (See appendix E.)

Any crewmember who has passed the operating rules examination is qualified to check a train register at intermediate locations. At intermediate locations, where there is no train order operator on duty and when directed to do so by train order, a train crewmember must register his train to indicate its status, or he must check the register

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to determine the status of another train, i.e., whether an opposing or superior train has arrived or left the register location. The crewmembers of Extra 6311 West were not required to register the train at Clear Creek, but they had been directed by train order No. 28 of August 2 to check the train register.

Crewmembers who register trains at intermediate locations are required to enter the train number and direction; the train order unit (lead locomotive unit number); COMPASS train I.D.; 5/ arrival of train on designated track or location; the names of the conductor, the engineer, and the brakemen; the number of loaded and empty cars; the tonnage; and the caboose number. The operating rules state that the train order number and date on which a train is being registered must be inserted in the column headed "signals carried." Each day's date must be entered by the crewperson signing the register. However, the date is entered at random below the last entry for the previous day or the last day the train register was signed, and not in the date blank provided at the top of the page. Instructions on procedures and entering train register information are covered in employees biennual rules examinations.

On August 1, Unit 6575 had been used as the train order unit for the gravel train. A crewmember of the train had dated and made the required entries in the train register according to the operating rules and train order No. 20 dated August 1, 1985. Also, at 8:30 p.m., a crewmember on Extra 6324 East had signed the train register at Clear Creek on train order No. 20 dated August 1, 1985. There were no entries in the train register for August 2, 1985. (See figure 6.)

Operating rule S-83(A) states:

> When a train is required to meet, or wait for, an opposing extra train, or when an extra train has been made superior to an opposing train, the train register must not be used as evidence of the arrival of such extra train, except as provided by Form W train order, Examples (5) or (6).
>
> Trains must not use the train register as evidence of the departure of an extra train, except as provided by train order.

Train order Form W, Change in Clearance or Register Requirements, states, in part:

| | |
|---|---|
| Example (4): | Extra 37 West register at<br>C on order<br>No. __ of (Date). |
| Example (5): | Extra 38 East may check register at<br>C against Extra 37 West on order<br>No. ___ of (Date). |
| Example (6): | No. 2 may check register at C<br>against Extra 37 West on order<br>No. ___ of (Date). |

* * *

5/ COMPASS is an acronym for computer assistance. The ID number is used by management or clerical forces to follow a train's activity. (The COMPASS I.D. for Extra 6311 West was 01-291-02, and for Extra 6575 East was 71822.)

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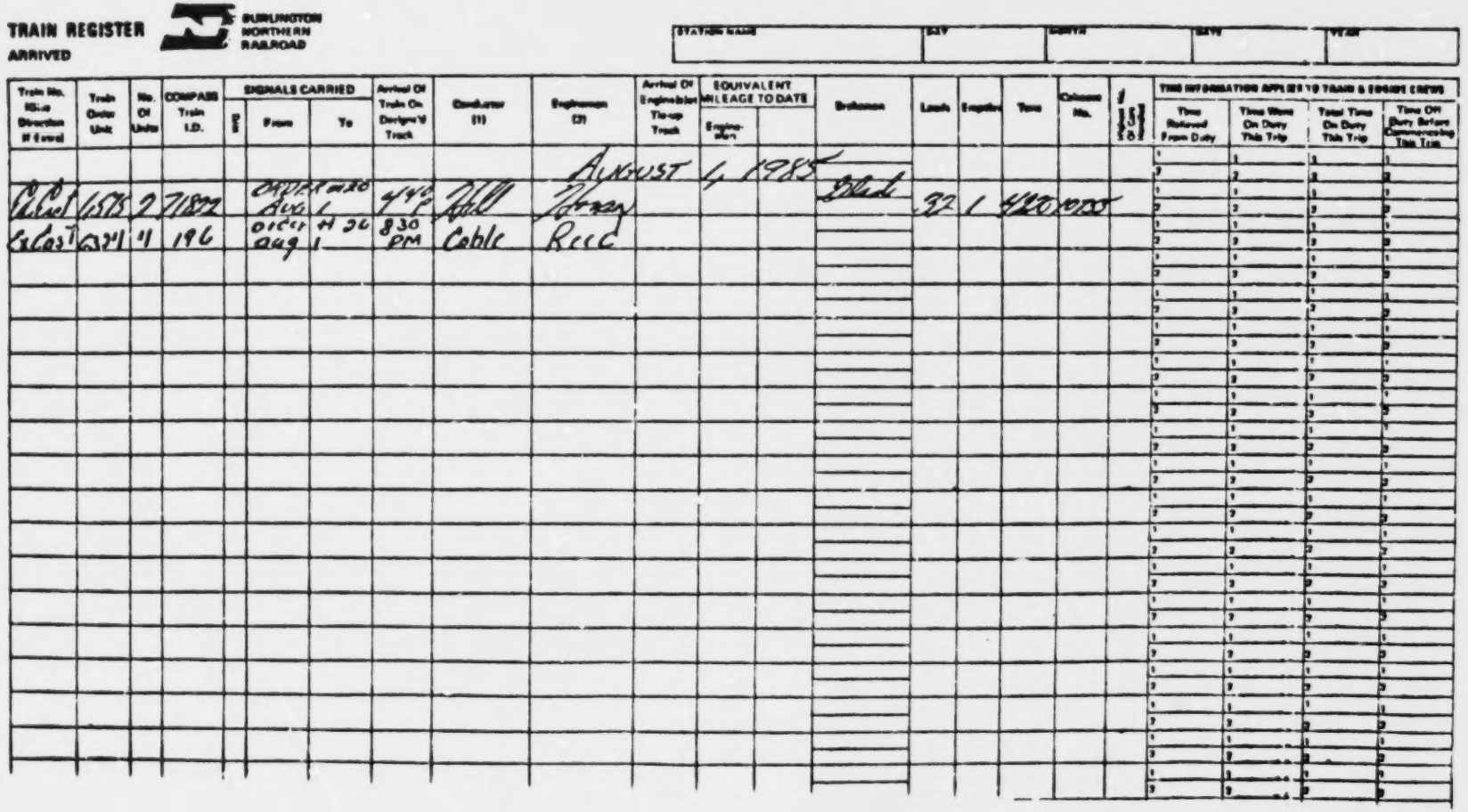

TRAIN REGISTER
ARRIVED

BURLINGTON NORTHERN RAILROAD

STATION NAME | DAY | MONTH | DATE | YEAR

| Train No. Symbol Direction If Event | Train Order Unit | No. Of Units | COMPASS Train I.D. | SIGNALS CARRIED Date | From | To | Arrival Of Train On Designated Track | Conductor (1) | Engineman (2) | Arrival Of Engine(s) at Tie-up Track | EQUIVALENT MILEAGE TO DATE Engine(s) | | Brakeman | Leach | Engineer | Time | Caboose No. | | TIME INFORMATION APPLIES TO TRAIN & ENGINE CREWS Time Relieved From Duty | Time Went On Duty This Trip | Total Time On Duty This Trip | Time Off Duty Before Commencing This Trip |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | AUGUST 4, 1985 | | | | | | | | | | | | | |
| EBed | 1575 | 2 | 71872 | | Orig Aug 1 | | 4:40 PM | Hill | Tobey | | | | Beck | 32 | 1 | 4:20 | 0000 | | | | | |
| EBCab | 0321 | 41 | 196 | | Orig Aug 1 | H 20 | 8:30 PM | Cable | Reed | | | | | | | | | | | | | |

Figure 6.--Train register sheet for August 2, 1985 (sheet 1).

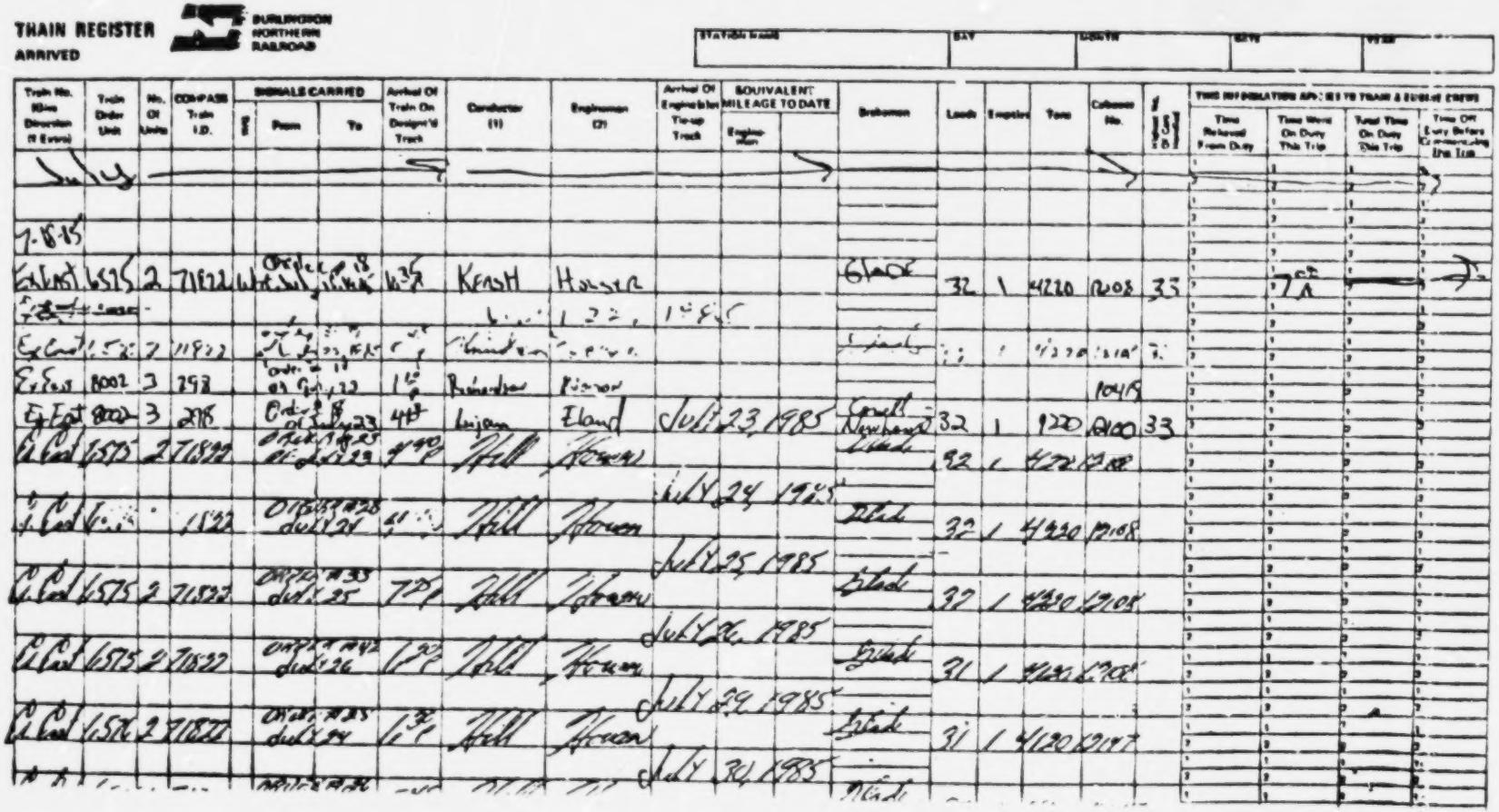


Figure 6.--Train register sheet (sheet 2.)



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Examples (4), (5) and (6) must be used when it is desired to permit a train to accept the train register as evidence of the arrival of an extra train in accordance with rule S-83(A).

When example (4) is used, number and date of the order must be inserted in the column of train register captioned "signals".

Before the Form W train order was modified by examples 4, 5, and 6, 6/ the dispatcher was required to issue a train order to the crew checking the register before the crew could accept and act upon the registered time as proof of the arrival or departure time of a superior or conflicting train.

Bulletin No. 122, which was to become effective at 12:01 p.m., Monday, April 22, 1985, was issued April 17, 1985, to establish Track Warrant Control (TWC) authority for the movement of trains on the Third Subdivision. Implementation of the TWC authority would have eliminated the need for a train register at Clear Creek and other designated locations. In application, the train dispatcher would be required to issue a track warrant authorizing a train to proceed from point A to point B only. The train would not be allowed to go past point B until the dispatcher issues another track warrant authorizing additional movement. (See appendix F.)

The provision for the establishment of Track Warrant Control authority was included in Timetable No. 4, which was to become effective on April 28, 1985. However, because of contractual differences with the Brotherhood of Railway, Airline and Steamship Clerks union, Bulletin No. 135 dated April 25, 1985 was issued to delete from Timetable No. 4 the use of the Track Warrant Control on the Third Subdivision, and the train register system was continued in service. The BN is pursuing the implementation of the TWC system for operation, and indications are that the difficulties are being worked out.

Gravel Train Operations.--On April 2, 1985, the BN began operating a seasonal unit gravel train over the Colorado Third Subdivision between Longmont, MP 43.6, and and the Western Paving Construction Company's facility at Clear Creek, MP 4.5. The gravel train has been in operation about 4 years, and it is operated Monday through Friday only from about April to October. In accordance with an agreement between the BN and the labor unions representing the labor crafts involved, the train is operated with a "short crew" i.e., an engineer, a conductor, and a brakeman, who report for duty at 7 a.m. at Longmont.

Cars loaded with gravel are accepted as loaded at a specified weight per car in accordance with an agreement between the BN and the Western Paving Construction Company. The weight of the gravel load is controlled closely by computerized monitoring equipment when the cars are loaded at Lyons, Colorado. The BN makes periodic weight checks to monitor the weight of the cars.

On July 13, 1985, the duty reporting time of the gravel train's crew was changed to 2 p.m. because of track work that was being done on the Third Subdivision. The later operating schedule enabled track forces to work with fewer interruptions, and it caused less delay to the gravel train en route to and from Longmont. The trip from Longmont to Clear Creek took about 1 hour 40 minutes.

6/ The change to the Form W train order appears in the Consolidated Code of Operating Rules, 1980 edition.

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At Clear Creek, the loaded cars are backed onto a wye track 7/ (see figure 1) belonging to the Western Paving Construction Company. As the train is backed around the wye, the loaded cars are dumped. After the cars have been emptied, which takes about 1 hour, the train is returned to Longmont. The crew is on duty between 7 and 8 hours.

The conductor and the engineer of the gravel train are provided with a "wheel report," which shows the makeup of the train, including the number of loaded and empty cars, and the initial, number, weight, origin, and destination of each car. The total train weight or load in tons is also provided so that the tons per operative brake can be calculated. The conductor or the engineer is responsible for calculating the tons per operative brake 8/ using one of the following methods:

(1) multiply the number of cars times the total car weight and compare the result with the actual train tonnage to determine the greater value;

(2) divide the tonnage load of the train by the total number of cars and compare the result to determine if the result is greater or less than 100 tons/operative brake; or

(3) add two zeros to the total number of cars with operable brakes (BN's suggested method) and compare the result with the total train tonnage.

The exact value for Extra 6575 East would be 4,089 Tons/32 cars equals 127.78 Tons brake. Following the BN's suggested method, 32 (cars) plus 00 equals 3,200 Tons. (The tonnage load was 4,089 tons, which is greater than the trial value.) Timetable and Special Instructions No. 4, effective at 12:01 a.m., April 28, 1985, limits the speed of all trains operating on the Third Subdivision which exceed a load of 100 tons per operative brake to 30 mph.

Train order operators report the train tonnage to the dispatcher. Neither the conductor nor the engineer is required to report to the dispatcher if the train is restricted to 30 mph because of the 100-ton per operative brake requirement.

**Communications**

The normal railroad communication facilities available to the train dispatcher at McCook consist of a radio, a dispatcher's telephone system, and a commercial Bell telephone system.

Radio System.--The circuit for the radio system is routed from McCook to Denver on commercially leased lines. At Denver, the circuit is switched through a bridging arrangement to divide the circuit. 9/ Part of the divided radio circuit is routed over the Union Pacific Railroad Company (UP) microwave facilities to Cheyenne. At Cheyenne, the radio circuit is returned to BN facilities over leased lines and is routed west to Wendover and east to Denver.

---

7/ A track configured like a "Y" (hence the name wye), which primarily is used to turn rail equipment. In most installations, a track spans the legs of the "Y" to allow equipment to make a reverse move and to complete the turnaround.

8/ A value determined from the number of cars with operable brakes and the train load (tons).

9/ An inductive or electronic arrangement to divide or split a communications circuit so it can be routed in divergent directions.

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Radio base stations are located at Longmont and Fort Collins, Colorado, and Cheyenne, Horse Creek, Chugwater, and Wheatland, Wyoming. The base stations are equipped with 45-watt transmitters. The location and spacing of base stations are designed to give overall area coverage and are not determined by distance separation.

The dispatcher does not monitor radio channel 1 constantly. To contact a train, the dispatcher must select the base station nearest the train's location and, through a switching arrangement, connect the base station radio facilities to his microphone and speaker. Therefore, a crewmember of a train on the Third Subdivision normally cannot make a direct radio contact with the dispatcher by a voice annunciation. To talk with the dispatcher, a crewmember of a train must contact by radio or telephone the train order operator nearest his location, who in turn calls the dispatcher on the dispatcher's telephone. Through the switching networks, the dispatcher selects the base station nearest the train and talks to the crewmember through the radio facilities at that station. Train-to-train communications are direct point-to-point contacts and the communications do not go through the base stations. However, train-to-train order operator or train-to-dispatcher communications are routed through the radio base stations. Crewmembers testified that, on occasion, the crews of a westbound train, such as Extra 6311 West, and an eastbound train, such as Extra 6575 East, had contacted each other by radio to determine the other train's location.

Railroad personnel who had communicated with the engineer on Extra 6311 West on August 2 reported that the radio on locomotive unit 6311 was operating satisfactorily. However, on several occasions, including July 31, the engineer of Extra 6575 East had reported the radio on locomotive unit 6575 as being "weak." The BN Superintendent of Communications stated that, on two of those occasions, BN radio technicians met Extra 6575 East at the Western Paving Construction Company to check the radio's performance. The radio was not replaced on either occasion. The crewmembers who operated Extra 6575 East between Lyons and Longmont on August 2 did not take exception to the radio's performance.

The radio in the caboose of Extra 6311 West was operable, and there were no complaints about its performance. However, the radio in the caboose of Extra 6575 East was inoperable because the coax lead to the antenna was uncoupled and the circuit breaker, which provided power to the radio set, was "tripped."

At the time of the accident, the BN was installing a system-wide radio annunciating system to provide locomotives with either a touch tone pad, similar to the type used on a touch tone dial telephone, or a tone button. In operation, a crewmember on the locomotive can call the dispatcher by dialing a prearranged digital code which will signal the dispatcher, who will respond by calling the base station nearest the train. At the time of the accident, neither locomotive unit 6311 nor unit 6575 had been equipped with the radio annunicating system.

On August 2 reliable radio communications were not available between mobile units on the Third Subdivision and the dispatcher at McCook because of flood damage at Cheyenne on August 1.

BN train crews and the dispatcher testified that radio communications on channel 1 were not reliable between train crews and the dispatcher in and around the Denver area. The dispatcher said that he seldom can use the radio effectively east of Golden or Boulder, Colorado, because of heavy use by employees on the yard at Denver. Also, trains crews cited dead spots 10/ as a source of trouble in radio communications.

10/ Locations where radio communications are either unreliable or not possible because the radio signals are blocked or diverted.

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A BN communication officer stated that work is underway to provide an additional radio channel for use in the Denver yard. Also, the Superintendent of Communications testified that the BN was attempting to overcome the radio difficulties in and around Denver by using a directional antenna and that neither increasing nor decreasing the output transmission power would improve the quality of service.

Telephone System.--The dispatcher's telephone circuit is routed over an open wire carrier system 11/ between McCook and Denver. At Denver, access to the dispatcher's telephone circuit is provided to the train order and CTC operators before the circuit is routed westward on open pole line facilities over the Third Subdivision to about Longmont. The telephone circuit for the area between Longmont and Cheyenne is covered by an open pole line circuit which originates at Cheyenne.

The dispatcher's telephone system is available at train order offices and at locations along the railroad where they are deemed necessary. At Clear Creek, the dispatcher's telephone is located in a T-box 12/ mounted on a telephone pole. (See figure 7.) The telephone has no ringing facilities and only the dispatcher can be reached from Clear Creek unless a train order operator at one of the train order offices is on the line at the time a caller at Clear Creek is using the telephone. The conductor of Extra 6575 East testified that, because the dispatcher's telephone at Clear Creek often was inoperative, he would have to use a commercial telephone to contact the dispatcher or train order operator. On August 2, the dispatcher's telephone system was reliable only between the 31st Street office and Longmont.

## Meteorological Information

At 7:50 p.m. on August 2, 1985, the weather at the Stapleton International Airport at Denver, about 20 miles northeast of the accident site, was reported as follows: scattered clouds at 5,000 and 9,000 feet with broken ceiling at 20,000 feet; visibility--20 miles; temperature--71° F.; relative humidity--61 percent; and wind from the southwest at 1.5 mph gusting to 5 mph. The visibility by natural light was good.

## Medical and Toxicological Information

Because of the smoke and heat from the fire following the collision, immediate rescue efforts were delayed, and some of the bodies were not removed from the wrecked equipment until late afternoon on August 3. A pathologist contracted by Jefferson County, Colorado, performed autopsies on the the head-end crewmembers of both trains. Toxicological tests on tissue, blood, and urine specimens were performed by an independent laboratory. All the tests were negative for alcohol and pharmaceuticals, except the tests for the engineer of Extra 6575 East. His blood sample indicated the presence of 0.12 percent ethanol alcohol. However, the vitreous humor of all crewmembers tested negative. The toxicologists therefore concluded that the alcohol detected in the blood of the engineer of Extra 6575 East was due to microbial action (putrefaction) and not from alcohol ingestion before the accident.

An analysis for carboxyhemoglobin (COHb) was negative for all crewmembers except the rear brakeman of Extra 6311 West. The COHb analysis for the rear brakeman indicated that carbon monoxide concentration was 25 percent saturation by

11/ An electronic transmission system by which many circuits can be transmitted over a single pair of wires or microwave channel by use of separate frequencies, which modulate a carrier frequency.
12/ A box used by railroads to house an outlying, unprotected telephone.

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Figure 7.--Train register box and T-box at Clear Creek.

spectrophotometric technique. By Co-oximeter, the test indicated a 17 percent saturation of carbon monoxide, and 17 percent of methemoglobin. The rear brakeman's lungs also contained fluid.

**Survival Aspects and Emergency Response**

When the two trains collided, the operating compartments of locomotive units 6575 and 6311 were structurally destroyed. However, the lead units did not burn during the ensuing fire. SP unit 7347 and another unit buried beneath it were engulfed in flames. The operating compartment of unit 6575 was not crushed; however, the nose of the locomotive and the supporting undercarriage were torn off.

The operating compartments of units BN 6311 and SP 7374 were crushed upon impact and produced an unsurvivable environment. The derailing cars piled upon and around the locomotive units causing a jumbled wreckage mass. When the trains collided, the lading of gravel from Extra 6575 East and the lading from the head cars of Extra 6311 West spilled and added to the wreckage debris.

Emergency forces from Westminster and other nearby communities, the Westminster Police, the Colorado State Police, and the Jefferson County Sheriff's Office started arriving at the scene about 20 minutes after the accident. The intense heat and the heavy smoke from the burning fuel and equipment delayed search and rescue efforts.

**Tests and Research**

At 7:30 p.m. on August 7, 1985, sight distance tests were made at the accident site. BN locomotive units 6339 and 6599, units similar to units 6311 and 6575, were used as test trains. The weather conditions were comparable to the conditions on August 2, and visibility by natural light was good. The two test trains placed nose-to-nose at the point of impact, were oriented with the short hood in the same direction as those of Extras 6311 West and 6575 East, and were backed away from each other at about the same speed. The speed differential between the two closing trains was not considered significant. Sight distances were measured at 100-foot intervals. By the use of radar measuring equipment, it was determined that the best straight line sight distance available between the two trains was 870.74 feet. The actual distance measured along the roadbed with the curvature of the track was 876.6 feet. Neither the bridge abutments nor the overhead bridge structure was standing when the sight tests were made. Stopping distance tests were not made.

The Barco speed recorders were removed from locomotive units 6311 and 6575 virtually intact. The glass window in the cover of the recorder from unit 6311 was cracked. The spool of recording paper was loose and the glass window in the cover of the recorder from unit 6575 was broken. However, both recorders were in a condition that would allow a reliable and accurate calibration. The recorders from each unit were tested with the following results:

| Unit | Wheel Size (inches) | Gear Teeth | Test Speed (mph) | Recorded Speed (mph | Deviation (mph) |
|---|---|---|---|---|---|
| 6575 | 40 | 48 | 20 | 20 | 0 |
| | | | 30 | 28 | -1 |
| | | | 40 | 38 | -2 |
| | | | 50 | 46 | -4 |
| | | | 60 | 55 | -5 |

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| Unit | Wheel Size (inches) | Gear Teeth | Test Speed (mph) | Recorded Speed (mph | Deviation (mph) |
|---|---|---|---|---|---|
| 6311 | 40 | 48 | 20 | 22 | +2 |
| | | | 30 | 31 | +1 |
| | | | 40 | 40.5 | +0.5 |
| | | | 50 | 50 | 0 |
| | | | 60 | 60 | 0 |

The overspeed controls were set at 68 mph and 82 mph for units 6311 and 6575, respectively. The impact speeds of Extra 6311 West and Extra 6575 East, 52 mph and 48 mph, respectively, were obtained from the speed tapes with the correction factor derived from the test results applied.

The radios on the locomotives were destroyed and could not be tested after the accident. When the radio set from the caboose of Extra 6311 West was connected to the antenna and power was applied, it was found to be in an acceptable operating condition. The portable radio used by the conductor of Extra 6575 East performed according to the manufacturer's specifications.

About 11:15 p.m. on August 2, a Safety Board investigator and a Federal Railroad Administration (FRA) inspector inspected the non-derailed cars in each train. The brakes were found applied and the brakeshoe wear and the brake cylinder piston travel were found to be within Federally specified tolerances.

On August 3, an initial terminal airbrake test was conducted on the non-derailed cars of each train. BN locomotive unit 2047 was coupled to the remaining 9 cars and caboose of Extra 6311 West and the brake system was charged with air for about 15 minutes. A broken auxiliary reservoir pipe on car WPGX 949914 caused the cars under test to have a 6 psi/minute leakage; however, when the auxiliary reservoir pipe was repaired, the leakage was 2 psi/minute, which is acceptable (5 psi/minute maximum leakage is allowed by Federal regulations). The break in the pipe was determined to consist of 70 percent old breakage and 30 percent new breakage. No exceptions were taken to the cars' brakes.

BN locomotive units 8110 and 6749 were coupled to the remaining 27 cars and caboose of Extra 6311 West and the brake system was charged. The leakage was determined to be 2 psi/minute, and no exceptions were taken to the cars' brakes.

**Other Information**

The train register book at Clear Creek was located on the fireman's side of Extra 6311 West mounted on the east side of a telephone pole on the south side of the track (by timetable direction) in a box about 6" X 24" X 36" with a desk-like sloping lid. (See figure 7.) The box was locked with a railroad switch lock, and there was no artificial illumination or protection from the weather for the box. No trees or obstructions are present that would block natural light from falling on the train register book when it is placed on the desk-like top of the box in which it is kept for purposes of reading it or making an entry.

The T-box housing the dispatcher's telephone is mounted on the same telephone pole supporting the box housing the train register book. The T-Box also is locked with a switch lock. (See figure 7.)

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## ANALYSIS

### The Accident

Operations.--On August 2, 1985, the train dispatcher and the operators at Longmont and the 31st Street Yard followed correctly the prescribed operating rules and procedures. However, the engineer of Extra 6575 East, unchallenged by the other crewmembers, operated the train 18 mph faster than the 30-mph speed limit allowed by the timetable special instructions. The crewmembers of Extra 6311 West failed to comply with the operating rules on two counts: the train departed Clear Creek without the proper authority; and, although not a particularly significant factor in the accident, the engineer of that train was operating 3 mph over the authorized 49-mph speed limit.

Since Extra 6575 East was restricted to 30 mph because the tonnage load exceeded the 100 tons per operative brake requirement specified in the timetable special instructions, the crewmembers allowed the engineer to operate the train overspeed in disregard of the speed restriction. The Safety Board cannot project how the higher speed rate might have changed the outcome of the accident. However, Extra 6575 East was traveling about 60 percent overspeed (30 mph vs 48 mph). The kinetic energy represented by the train at 48 mph was 344,391.2 Ft-Tons, whereas at 30 mph, the kinetic energy was 134,527.8 Ft-Tons, a difference of 209,863.4 Ft-Tons. If the lower and authorized speed had been observed and if the accident could not have been prevented, the lesser energy expediture would have increased the chances of the accident being a survivable one. Also, at some other point on the railroad, there may have been sufficient time for the engine crews to have gotten clear of the train before the trains collided.

When one of the crewmembers on the locomotive of Extra 6311 West checked the train register at Clear Creek, he failed to perceive that the information recorded in the train register book was about Extra 6575 East of August 1. As a result of his misperception, he provided the other crewmembers with the incorrect information about Extra 6575 East. There were no surviving witnesses who could testify that they saw the crewmember unlock the register box, remove the train register book, and read the entries. The train was standing between the witness in the Western River Paving Construction Company so the witness' vision was blocked. However, since the 4:40 p.m. time quoted by a crewmember in the radio report to the conductor is a factual entry of record, the Safety Board concludes the train register book was removed from its repository and viewed by a crewmember. Since it is not known for certain who read the train register, the Safety Board could not determine the circumstances surrounding the dissemination of incorrect train register information. Although the tape recording of the radio message from the crewmember on the locomotive was not of good quality, probably because of the distance between Clear Creek and the Longmont radio base station, the reception of the message on the caboose by the conductor would have been more easily understood.

According to the BN rules examiner's interpretation of rule 83(A), the conductor of Extra 6311 West was not required personally to sign or examine the Clear Creek train register because it was considered an intermediate terminal. Therefore, because they were all qualified on the book of operating rules, it was proper and within the scope of the operating rules for any one of the three crewmembers on the locomotive to check the train register. The locomotive of Extra 6311 West could not have been operated past the location of the train register before stopping because the train would have been west of Clear Creek and in violation of train order No. 28, which gave Extra 6575 East right over Extra 6311 West between Longmont and Clear Creek. Extra 6575 East was authorized to

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come to Clear Creek to sign the train register. Therefore, if the conductor of Extra 6311 West had been required or had elected to check the train register, he would have had to walk about one-half mile from the caboose to the train register, opposite the locomotive.

Generally, the gravel train arrived at Clear Creek earlier than it would have on August 2. Therefore, the information that Extra 6575 East had arrived at Clear Creek at 4:40 p.m. on August 2 was probably not surprising to those crewmembers who had not read the train register. Between 4:40 p.m. and 7:10 p.m., the crew of Extra 6575 East would have had ample time to have proceeded from Longmont to Clear Creek, dumped the train load of gravel, and departed Clear Creek for the return trip to Longmont. The crew of Extra 6311 West had a copy of train order No. 28 and they knew Extra 6575 West could return to Longmont ahead of Extra 6311 West.

However, if the crew of Extra 6311 West had been more alert, they should have noticed that train order No. 28 was not issued until 5:07 p.m. Since the crewmembers of Extra 6311 West were experienced on the Third Subdivision, they should have recognized that, based on the running time of about 1 hour 40 minutes for Extra 6575 East to run from Longmont to Clear Creek, and the time that train order No. 28 was issued, Extra 6575 East could not have arrived at Clear Creek before 6:45 p.m. Further, if the crew of Extra 6311 West had allowed Extra 6575 East an hour to dump the gravel, the task would not have been completed until 7:45 p.m. If this logic had been developed, the crew of Extra 6311 West should have questioned why Extra 6575 East was not still in the wye track at Clear Creek. Even if the crewmembers of Extra 6311 West had not known the actual running and unloading time required by Extra 6575 East from Longmont to Clear Creek, the fact that train order No. 28 was not issued until 5:07 p.m. should have alerted the crew of Extra 6311 West that Extra 6575 East could not have registered at Clear Creek at 4:40 p.m., which was before the train order was issued.

The crewmembers were experienced in train orders and the train register method of train operations. The ambient natural light was bright enough so that even without artificial illumination, no problem should have been experienced in clearly seeing the well defined, legible, and correctly inserted entries for August 1 in the train register. All of the crewmembers were reported to be physically alert. There were no known medical disorders, visual difficulties, or other problems that would have caused any one of them to make such an error. The only crewmember whose behavioral pattern appeared to be a little different that day was the rear brakeman, and it is not known whether or not he read the train register. Therefore, the Safety Board could not determine the reason the information contained in the train register at Clear Creek concerning the registry of Extra 6575 East on August 1 was perceived erroneously and relayed to the other crewmembers as the status for Extra 6575 East on August 2.

When the Form W train order was modified as a revision of the Consolidated Code of Operating Rules by participating railroads, the required contact with the dispatcher was eliminated since the train order authority to accept the train register information was not needed. As a result, a positive check for the arrival of a conflicting train also was lost. Rule S-83(A) and example 5 of the rule gave the crew of Extra 6311 West the authority to use the train register information as evidence of Extra 6575 East's arrival at Clear Creek. Therefore, since there was no rule requiring the crew of Extra 6311 West to check with the dispatcher or one of the train order operators on either side of Clear Creek to determine the location of Extra 6575 East, no attempt was made to contact any of these or the train. Moreover, since the lead locomotive unit for Extra 6575 East on August 2 was the same lead unit that had been used on the gravel train on August 1, a casual glance probably would not have caused anyone reading the register to detect any difference in the date of a day's separation. Train order number 20 dated August 1, on which Extra

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6575 East signed the register at Clear Creek on August 1, was properly recorded in the train register book in the "signals carried" column. The train order was numbered in the same tens series as number 28 issued on August 2. However, the entry in the train register of a train arriving at 8:30 p.m., a time not yet occurring on August 2, should have caused the reader to question his identifying the gravel train's arrival at 4:40 p.m.

Under the circumstances, such similarities could have been conducive to misreading the train register if the person reading the register was not concentrating on his task. The BN does not require crewmembers who check the train register to make the check with the effective train order in hand, so that a comparison can be made between the train order and the entry in the train register. However, during the Safety Board's deposition proceeding, some crewmembers testified that this procedure voluntariiy was followed on occasions.

The conductor said that on August 2, he did not discuss the train orders with the engineer of Extra 6311 West because he was being hurried by yard personnel to move the train out of the yard. However, since rule 214 states that, "when practicable" the conductor and engineer must have an understanding of train orders addressed to them, which would be confirmed by a discussion, the conductor's not doing so cannot be termed a rules violation. Under the pressure exerted upon him to leave the yard, the conductor could have decided that in this instance complying with that part of rule 214 was not practicable. Also rule 214 states that all crewmembers are responsible for complying with the requirements of train orders. The crewmembers fulfilled the requirement of the train order by checking the register at Clear Creek, and even though the information or the lack of recorded information for August 2 was correct, the register was interpreted erroneously and provoked the wrong action. In all probability, for crewmembers, an understanding of the train order is the understanding of the requirements of the order. They may check the order number against the clearance card, the date, and perhaps, the completion time. The BN should insure that train crews compare and discuss train orders with other relevant times and dates. Had such a discussion of the train orders and relevant times occurred between the crewmembers of Extra 6311 West, this accident might have been prevented.

Operational Alternatives and Procedures.--At the time of the accident, the BN did not provide the train crew with any alternative as a backup for verifying the train register information, except the Form W train order. The Form W train order permitted the train crew of Extra 6311 West to use the train register information as evidence that Extra 6575 East had arrived, but there was no requirement that any other action be taken to verify the information shown in the train register.

Nevertheless, there were available options. The crew of Extra 6311 West could have contacted by radio the CTC or train order operators at the 31st Street Yard or the train order operator at Longmont to determine the location or status of Extra 6575 East, or the crew could have contacted by radio the crew of Extra 6575 East. Any one of the crewmembers on the locomotive of Extra 6311 West could have called the dispatcher using the telephone located in the T-box at Clear Creek. During the deposition proceedings, crewmembers testified that on occasion, under circumstances similar to those of the day of the accident, the crews of the two trains had contacted each other by radio to determine the other's location. None of these efforts are required by the BN operating rules or procedures and none were done on the day of the accident.

At least two options were available to the dispatcher on August 2. First, he could have held Extra 6311 West at Utah Junction until Extra 6575 East arrived at Clear Creek or as a minimum, until Extra 6575 East's running time from Longmont had expired. If

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Extra 6311 West had arrived at Clear Creek before Extra 6575 East (as it did), then Extra 6311 West would have had to make a reverse move across the D&RGW crossing at Utah Junction so that Extra 6575 East could gain access to the Western Paving Construction Company's wye track. Secondly, the dispatcher could have given the two trains a train order to meet at Broomfield, or another suitable location. The dispatcher said he did not provide a meet between the two trains at Broomfield because he did not know the time Extra 6311 West would leave the Denver yard. The most efficient and best move would have been for the train dispatcher to have held Extra 6311 West at Utah Junction until Extra 6575 East arrived at Clear Creek. Although the movement of Extra 6311 West did not become the responsibility of the train dispatcher until the train left Utah Junction, the dispatcher's permission should have been obtained before Extra 6311 West entered onto the main track under his control.

Responsibility for the Safety of the Train.--The Safety Board has investigated several accidents in which it has taken the position that the conductor should be in a position on the train to immediately know current operating conditions. 13/ Based on more than 30 major railroad accidents which involved the issue of joint responsibility assigned by the operating rules to the conductor and engineer for the safety of the train, the Safety Board recommended on May 16, 1985, that the FRA:

> Require that there be at least two crewmembers on locomotives of through freight trains who are qualified to operate the locomotive, that one of these two persons have total responsibility for the train and all employees thereon, and that the second person serve as the assistant to the person in charge. (Class II, Priority Action) (R-85-51)

A similar Recommendation, R-85-52, was issued to the Association of American Railroads (AAR), the United Transportation Union, and the Brotherhood of Locomotive Engineers.

At this time, neither the FRA nor the United Transportation Union has responded to the Safety Board's recommendations. The AAR has objected to the intent of the recommendation; the Board, however, in further dialogue with the AAR has urged the AAR to reconsider the safety benefits implicit in the recommendation. The Brotherhood of Locomotive Engineers agrees with the Board's recommendation and is following up with the FRA and the industry, urging implementation of this concept. The Safety Board believes that if the conductor had been riding on the locomotive when Extra 6311 West arrived at Clear Creek, he could have read the train register, even though BN's interpretation of rule 83(A) does not require it, and the accident might have been prevented.

During the course of many accident investigations, the Safety Board has heard statements from railroad supervisors that if the rules were obeyed, accidents would not happen. This logic cannot be refuted so long as the rules are adequate. However, in many instances, railroad operating officers will not provide backup measures for safety assurance in case a rule is willfully or unintentionally broken. The Safety Board believes

13/ Railroad Accident Report--"Rear End Collision of Two Burlington Northern Freight Trains at Sheridan, Wyoming, March 28, 1971" (NTSB-RAR-72-4); Railroad Accident Report--"Penn Central Transportation Company Train Collisions, Leetonia, Ohio, June 6, 1975" (NTSB-RAR-76-2); Railroad Accident Report--"Rear End Collision of Two Seaboard System Railroad Freight Trains at Sullivan, Indiana, September 14, 1983" (NTSB/RAR-84/2); and Railroad Accident Report--"Head-On Collision of Two Burlington Northern Freight Trains at Motley, Minnesota, June 14, 1984" (NTSB-RAR-85-06).

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that if the railroad operating officers would provide safety backup procedures to safeguard train operations, many accidents would be prevented. Historically, railroad operating officers have been reluctant to provide backup procedures in the event of a rule's violation. Redundant safety procedures are essential in all transportation operations to ensure the highest levels of safety.

The Train Register.--BN supervisors assured Safety Board investigators that all necessary guidance for using the train register was covered in the biennial rules examinations. However, since all of the information provided for by column headings on the train register is not required at all register locations, the Safety Board believes the train register sheet could be simplified at intermediate locations. The Safety Board understands the problem of adapting the train register book for each location since it is used in various locations on the BN system. However, the August 2 accident has pointed out the need for instituting a procedure that will reduce the possibility of a train crewmember's misreading train register information. At the time of the accident, BN operating officers stated that plans were being made for the Track Warrant Control system to supplant the train register system in the very near future. Since April 27, 1986, when the BN replaced the Consolidated Code of Operating Rules with the General Code of Operating Rules as the BN's operating authority, and placed the TWC system of operation into service on a number of subdivisions including the Third Subdivision, train orders and intermediate train registers have been discontinued at these locations. As of May 13, 1986, the BN had placed the TWC system of train operation into service on 37 Subdivisions of the system. By the end of 1986, the BN expects to be using the TWC system on 90 Subdivisions and it plans to have the entire system operating with TWCs by the end of 1987. However, as long as the train register system is being used on the BN system, a backup system should be implemented to provide the safest operation possible.

The Track Warrant Control System.--The TWC system seemingly would provide a more positive control over train movements than the train register or train order, and the dispatcher should be able to monitor a train's progress more closely because he would have current information concerning the locations and movements of all trains. Train crews would have positive meet arrangements and would have to obtain the dispatcher's authority to go beyond a specified operating limit. However, the safety involved in the TWC method of moving trains still depends on the train crews obeying the TWC authority and the operating rules.

On April 6, 1984, the Safety Board investigated a train collision involving the TWC operation on the Atcheson, Topeka and Santa Fe Railroad at Castor, Texas. The TWC operation had become effective on February 1, 1984. The crew of an eastbound freight train had received a TWC to proceed to Castor and to clear the main track in the siding for a westbound freight train. The fireman, who was operating the train, became confused and thought that his train was to stay on the main track. (The engineer was in the engineroom checking on a problem.) The westbound train arrived at Castor first and as a result, since it was on the main track, the eastbound freight train collided head-on with the westbound train. One person was killed in the accident.

As the April 6 accident indicates, the TWC authority is not a means to end all accidents. Moreover, the TWC most likely will impose a heavier workload on the train dispatcher, which could be dangerous. Therefore, all employees involved in train operations should be well trained in the TWC's application and use. When the BN placed the General Code of Operating Rules and the TWC system into service on the Third Subdivision, an extensive rules training program was carried out. For several days after the April 27, 1986 implementation date, company officers and supervisors worked with the employees on the job to assist the operating employees, including the train dispatchers, to become familiar with the new rules.

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**Non-Critical Elements**

Equipment.--Safety Board investigators examined and tested the non-derailed equipment of both trains. The brakes on the cars operated satisfactorily and the piston travel was within tolerance. Although it was not possible to conduct an operational test on the brakes of the locomotive units, no exceptions were taken to those controls and valves that could be examined. Based on the results of the inspections and tests, the Safety Board concluded that the brakes of each train were fully operable and would have stopped the trains if they had been applied in sufficient time. Also, the results of the calibration tests on the speed recorders of each locomotive indicate that the recorders were sufficiently accurate. Therefore, the engineers should not have had any difficulty adhering to the posted speed limits.

Communications.--The locomotive radios could not be tested after the accident so it is only possible to analyze their performance on the reports concerning their operation. No adverse reports were made concerning the radio on Extra 6311 West so it must be assumed that the radio was operating satisfactorily.

Since the engineer had complained about the performance of the radio on Extra 6575 East at several different times, it must be assumed that it was operating less than satisfactorily on August 2. If the radio on unit 6575 had been operating properly, the engine crew might have overheard the transmissions made by the crew of Extra 6311 West while the train was at Clear Creek or MP 10. However, since frequency modulation (FM) depends on line of sight for optimum transmission and reception, it cannot be concluded that any or all transmissions from Extra 6311 West would have been received by Extra 6575 East even with a high quality receiver. Uneven terrain or objects, such as buildings, could have blocked or deflected the FM radio signal so that it would never have reached Extra 6575 East.

The Safety Board could not determine the effect of the radio system outage on the circumstances involving this accident. Since the engineer of a train normally cannot contact the dispatcher directly, it is questionable whether the engineer of either train would have gone through the routine of raising the dispatcher. If the radio system had been operable, even with a heavier work load, the dispatcher may have had the base station at Longmont "tuned in" and he might have stopped the movement of Extra 6311 West before the accident. However, since there is no concrete evidence to support the effect the disrupted radio service might have had on the outcome of the accident, it cannot be concluded that the outage of the radio system had any bearing on the accident.

The train dispatcher at McCook testified that even under the best atmospheric conditions, it was difficult for him to contact a train by radio in the Denver Yard or in the vicinity of Denver or to contact the operators at the 31st Street Yard. The problem in part is caused by the heavy usage of channel 1 in and around Denver and the distance between Denver and the location of the base station at Longmont, which serves the Denver area. The Longmont base station is apparently too far away to adequately serve the Denver area. Better coverage and improved communications might be achieved in the area if the point-to-point communications were routed through a repeater base station to increase the signal strength, if channel 2 could be used, or if the BN could obtain another channel to serve the Denver area. The lack of response to the emergency calls made by the conductor of Extra 6311 West probably was due to the conductor's radio signal not being heard in the Denver Yard area, which could have been the result of the transmission path, with incompatible terrain or obstacles to FM signals, or low receiver sensitivity. Additionally, when a radio transceiver is being used to transmit, the receiver will not simultaneously receive incoming signals. Also, if a transmitter has limited output power,

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as in the case of hand portables, or if the output power has deteriorated, the range of the radio is limited, and it may not be transmitting a signal strong enough to activate a distant receiver. The optimum range of a portable radio is about 5 miles. No doubt many employees in the Denver Yard were using portable equipment and the distance between the conductor at MP 12.5 and the Denver Yard was too great for effective communications. The BN should strive to provide more reliable radio communications over its territory in the Denver area. When the TWC method of operation is implemented, the radio will become more important than it has been in the past.

The Safety Board has long been interested in the application of radio use to railroad operations. Safety Recommendations have been issued to the FRA since 1976 addressing the need for radios to be required equipment on trains, the need for compatibility of radios between railroad properties, and the need for standards governing the use of radios in the industry. Recommendations also have been issued to various individual properties on the same issues.

In its report of a train derailment at Essex Junction, Vermont, on July 7, 1984, 14/the Safety Board cited the following statement made by the FRA Administrator at the National Transportation Safety Board's National Accident Investigation Symposium held in Washington, D.C., July 30-August 1, 1984.

> There were two things that I found imponderable before coming to FRA. One was the difficulty in reaching an agreement among all of the parties that would address in a fair way the alcohol and drug issue.
>
> The second imponderable was why we have been unable to develop a consistent program of radio communication in the railroad industry. Having addressed the first problem, we do intend to move to address the second, and we are going to begin proceedings that deal with the issue of communication, radio communication among railroad operating vehicles.

The Safety Board stated, in part:

> [It] appreciates the concern expressed by the FRA Administrator over a year ago and urges the FRA to move swiftly in its efforts to address the use of radios and radio communication standards to improve operational safety in the railroad industry.

To underscore its concern for this issue, on January 15, 1986, the Board recommended that the FRA:

> Establish regulations that address the issues surrounding the use of radios for operational purposes on trains to include, but not be limited to, requirements for radios to be installed on trains; usage requirements for inter- and intra-train communications; usage requirements for dispatching and control operations; frequency compatibility requirements; and maintenance, inspection, and testing requirements. (Class II, Priority Action) (R-85-129)

14/ Railroad Accident Report--Derailment of Amtrak Passenger Train No. 60, The Montrealer, on the Central Vermont Railroad near Essex Junction, Vermont, July 7, 1984" NTSB/RAR-85/14).

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On May 8, 1986, the FRA Administrator responded that:

> An examination of the industry's communication procedures and practices is a major element of FRA's safety agenda for this year.
>
> In the near future, I plan to initiate public hearings on the safety issues relating to railroad radio communications, including the central question of mandatory installation and use of radios. These hearings could well provide the basis for the development of an industry-wide set of technical and operational standards for radio communications or an FRA rulemaking should the data justify it.

The Safety Board is pleased to learn of the FRA's intended action concerning radio communications, and it urges the FRA to expedite its efforts in this area. However, until such action is taken, the Safety Board reiterates Safety Recommendation R-85-129.

**Toxicological Tests**

The alcohol content found in the analysis of the blood sample taken from the engineer of Extra 6575 East resulted from microbial action. Because of the smoke and heat from the fire following the collision, immediate rescue efforts were delayed. After the rescue operations started and the bodies were recovered, some of the bodies were not removed from the accident site until late afternoon on August 3. Since it was a hot day, this exposure gave rise to the deterioration of the bodies. Therefore, the Safety Board concludes that alcohol or drugs were not involved in this accident. Also, based on the results of the analysis for carbonhemoglobin, the rear brakeman must have lived a short time following the collision.

**Sight Distance**

The conductor of Extra 6575 East testified that he saw the headlight of Extra 6311 West as it emerged from beneath the highway bridge. Thus, it can be concluded that the visibility was good. However, given the sharpness of the curve at MP 12.5 with the bridge structure and abutments located in the line of sight, the distance available for the locomotive crews to see each other was very limited. The maximum optimum sight distance established during the sight tests was about 870 feet, which probably was more than that available to the engine crews of the two trains because the bridge and the abutments had been removed at the time the sight tests were made. The only obstruction that remained at the time of the sight tests was the earth fills for the bridge approach. Therefore, the Safety Board could not determine the exact sight distance available to the crews of the freight trains, but it was insufficient to have enabled either train to have stopped once the other was sighted.

**Survival and Emergency Response**

The speed at which the two trains collided and the heavy load hauled by the gravel train would have caused an unsurvivable environment for those employees riding the locomotive of each train. In addition, the fire fed by the diesel fuel and lading from Extra 6311 West, which made it impossible for rescue personnel to get to the wreckage, reduced the chances of survival. The Safety Board believes this accident was not survivable.

Some emergency and rescue personnel rushed to the accident site when they saw the black smoke coming from the fire at the point of the accident. The emergency response by the emergency and rescue forces was timely and very effective. Even though the rescue forces were delayed in getting into the wreckage because of the fire, they were on hand and available when needed.

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## CONCLUSIONS

### Findings

1. The operating rules and procedures had been followed properly by the dispatcher at McCook and the train order operators at Longmont and the 31st Street Yard.

2. The crewmembers of each train had more than the required hours of rest between assignments, and fatigue should not have been a causal factor in the accident.

3. There were no mechanical discrepancies in either train.

4. Rail traffic was heavier than normal on August 2 for the 3 p.m. to 11 p.m. shift on the Third Subdivision because of the flood at Cheyenne on August 1, 1985.

5. Neither alcohol nor drugs were involved in this accident.

6. Extra 6575 East exceeded the 100 tons per operative brake requirement and was thus limited to 30 mph. However, the speed tape indicated that the train was traveling about 48 mph at the time of the accident.

7. In addition to the train order, the engineer of Extra 6311 West was given verbal instructions by the conductor to check the train register at Clear Creek.

8. Since all crewmembers of Extra 6311 West had passed the operating rules examination, each was qualified to check the train register at Clear Creek.

9. One of the crewmembers on Extra 6311 West relayed to the other crewmembers erroneous information about the arrival of Extra 6575 East.

10. It could not be determined conclusively which crewmember on the locomotive of Extra 6311 West checked the train register at Clear Creek since all three employees were qualified to do so.

11. Locomotive unit 6575 had been used as the lead unit on the gravel train on August 1, 1985, and that entry into the train register could have been a factor in causing the crewmember to misread the train register information on August 2, 1985.

12. There was no evidence of any medical factors being involved to have caused a misreading of the train register.

13. Only limited radio communication facilities to and from the dispatcher were available on the Third Subdivision on August 2, 1985, and the quality of service and the coverage of the dispatcher's telephone circuit was limited and reliable only as far west as Longmont.

14. Extra 6311 West and Extra 6575 East did not communicate with each other on August 2, 1985, and neither overheard any radio transmissions from the other.

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15. The conductor of Extra 6311 West was unable to contact the operators at 31st Street Yard on BN radio channel 1.

16. The speed recorders were sufficiently accurate so that the engineers of each train could have maintained the authorized speed within 2 to 5 mph with no difficulty insofar as keeping within the speed limits.

17. In view of the high speed and heavy loads involved in this accident, the crash was not survivable.

18. The emergency and rescue forces responded in a timely manner, but rescue efforts were impeded because of the fire following the collision.

**Probable Cause**

The National Transportation Safety Board determines that the probable cause of the accident was the failure of a crewmember of Extra 6311 West to read the train register information correctly at Clear Creek, Colorado, and the failure of the conductor to correlate that information with the train orders which caused Extra 6311 West to depart Clear Creek before the arrival of Extra 6575 East, a superior train. Contributing to the severity of the accident was the overspeed of Extra 6575 East.

## RECOMMENDATIONS

As a result of its investigation of this accident, the National Transportation Safety Board made the following recommendations to the Burlington Northern Railroad:

> Implement, at intermediate train register locations, a backup procedure, such as telephone or radio verification of train arrivals, to provide train crews with a positive check on the status of other trains so long as the train register method is in operation. (Class II, Priority Action) (R-86-13)
>
> Require crewmembers who check train registers at intermediate locations to sign the train register and to provide the conductor and the engineer with the register information on the reverse side of the clearance card. (Class II, Priority Action) (R-86-14)
>
> Modify the radio system in use in the Denver area to provide reliable coverage in that area and to provide reliable and direct communications between mobile units and the train dispatcher at McCook. (Class II, Priority Action) (R-86-15)

As a result of this investigation, the National Transportation Safety Board reiterates Safety Recommendation R-85-129 to the Federal Railroad Administration:

> Establish regulations that address the issues surrounding the use of radios for operational purposes on trains to include, but not be limited to, requirements for radios to be installed on trains; usage requirements for inter- and intra-train communications; usage requirements for dispatching and control operations; frequency compatibility requirements; and maintenance, inspection, and testing requirements.

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**BY THE NATIONAL TRANSPORTATION SAFETY BOARD**

/s/ PATRICIA A. GOLDMAN
Acting Chairman

/s/ JIM BURNETT
Member

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

June 20, 1986

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## APPENDIXES

## APPENDIX A

## INVESTIGATION

The Washington Headquarters office of the National Transportation Safety Board was notified of this accident about 11:45 p.m. on August 2, 1985, by a Railroad Accident Investigator at the Safety Board's Denver Field Office. The investigator at the Denver Field office responded to the accident within minutes following the collision after he had been notified of the accident by a Broomfield, Colorado-Volunteer fireman. On August 3. 1985, an investigating team was dispatched from the Headquarters office to Denver where they were joined by an investigator from the Los Angeles Field Office. Parties to the investigation were the Burlington Northern Railroad, the Federal Railroad Administration, the Colorado State Highway Patrol, the Colorado State Highway Department, and the Jefferson County Sheriff's Office.

On October 30, 1985, a deposition proceeding was convened at Denver to take the sworn testimony of nine witnesses. Parties to the depositions were the Burlington Northern Railroad, the American Train Dispatcher's Association, the Brotherhood of Locomotive Engineers, the United Transportation Union, and the Colorado Public Utilities Commission.

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## APPENDIX B

## PERSONNEL INFORMATION

Train Dispatcher

Mr. James W. Hollis, about 35, had worked for the Chicago, Milwaukee St. Paul and Pacific Railroad Company as an extra operator and as a train dispatcher before he was employed by the BN as an extra train dispatcher in February 1976 at Alliance, Nebraska. On April 15, 1985, he was assigned to the 3 p.m. to 11 p.m. shift at McCook.

TRAIN CREW EXTRA 6311

Engineer

Mr. J. Reeves, 58, had been employed by the former Colorado and Southern Railroad Company (C&S) as a fireman in September 1949. He was promoted to engineer in October 1956. His service record indicates that he received disciplinary action in 1962 and 1964. In each instance, he operated a yard engine through and damaged a track switch, in the 1964 instance causing the locomotive to derail. In 1970, he was dismissed once for his involvement in a collision and a second time for his failure to observe a reduced speed requirement which resulted in a derailment. In both instances, he was reinstated with his full seniority rights restored. On March 18, 1981, he was commended for promptly responding to a report that a car was derailed in his train and for bringing the train to a stop before any damage was done.

Rear Brakeman

Larry A. Baril, 46, was employed by the former C&S Railroad Company on March 28, 1960 as a switchman. On April 22, 1974, he received a dual promotion to the positions of brakeman and conductor. His service record indicates that he was censured in 1963 and in 1964 for his involvement in sideswiping incidents.

Head Brakeman

Ronald E. Jordan, 37, was employed by the former C&S Railroad Company on August 20, 1979 as a student brakeman. He was promoted to brakeman on September 10, 1979 and to conductor on October 2, 1980. He had no censures or disciplinary actions notated in his service record. He had completed one year of college.

Conductor

Howard L. Lynn, 58, was employed by the former C&S Railroad Company as a brakeman in 1957. He was promoted to freight conductor in 1961, and in 1966, he resigned from the C&S. He was re-employed by the C&S in January 1970 and he was promoted to conductor the same year.

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## APPENDIX C

## TRAIN ORDERS EXTRA 6575 EAST

Rec'd O.W.I.V.
9:56 PM
D Kuntz

CLEARANCE

BURLINGTON NORTHERN RAILROAD

Forsyth (STATION) Aug 2 (DATE) 19 85

TO: C&E Extra 6575 West at Plevna Yard
Copy of OE Extra 6575 East

Clearance No. _____ TO _____

I have 1 orders for your Train

| | | | | | | |
|---|---|---|---|---|---|---|
| No. | 27 | | | | | |
| No. | | | | | | |
| No. | | | | | | |
| No. | | | | | | |
| No. | | | | | | |

| To be filled in when spacing trains Do Not leave before M | TIME OK'D 615 P.M. |
|---|---|

CHIEF DISPATCHER _____ OPERATOR _____

FOR TIMESLIP INFORMATION ONLY
YOUR COMPASS TRAIN NO: _____
(This number must appear on your timeslip)

FORM 15215 8-79 (OVER)

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# TRAIN ORDER No. 27

BURLINGTON NORTHERN RAILROAD

| LOCATION | DATE |
|---|---|
| LONGMONT | AUG 2 1985 |
| TO C&E EXTRA 6575 WEST AT CLEAR CREEK | |
| TO CARE OF C&E EXTRA 6575 EAST | |
| TO | |
| TO | |
| TO | |

EXTRA 6575 WEST HAS RIGHT OVER EXTRA 8060 EAST

AND EXTRA 8160 EAST CLEAR CREEK TO LONGMONT

EXTRA 6575 WEST REGISTER AT LONGMONT

ON ORDER NO 27 OF AUG 2

EXTRA 8060 EAST AND EXTRA 8160 EAST

MAY CHECK REGISTER AT LONGMONT

AGAINST EXTRA 6575 WEST ON ORDER NO 27 OF AUG 2

JWH

| TIME COMPLETED | OPERATOR |
|---|---|
| 455 pm | |

FORM 15108 1-82 READ ALL TRAIN ORDERS PROMPTLY. DISCUSS, UNDERSTAND AND COMPLY WITH THEM U.S.A.

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CLEARANCE

BURLINGTON NORTHERN RAILROAD

Longmont Aug 2 19 85
STATION DATE

TO: C&E Extra 6575 East

Clearance No. _____ TO _____

I have 6 orders for your Train

| No. | 631 | 635 | 27 | 28 | 39 | 44 |
|---|---|---|---|---|---|---|
| No. | | | | | | |
| No. | | | | | | |
| No. | | | | | | |
| No. | | | | | | |

| To be filled in when spacing trains Do Not leave before M. | TIME OK'D 614 P M. |
|---|---|

JWH
CHIEF DISPATCHER

Tilson
OPERATOR

FOR TIMESLIP INFORMATION ONLY
YOUR COMPASS TRAIN NO: _____
(This number must appear on your timeslip)

FORM 15215 8-79

(OVER)

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TRAIN ORDERS

BN RAILROAD TRACK WARRANT CONTROL RESTRICTED TRACK CONDITIONS

RTC NO 631 AUG 1 1985

TO: C&E WESTWARD TRAINS AT 31ST ST YARD
C&E EASTWARD TRAINS AT CHEYENNE
C&E TRAINS ORIG AT FT COLLINS
C&E TRAINS ORIG AT LONGMONT

FROM 601 AM UNTIL 601 PM MONDAY THROUGH FRIDAY DO NOT EXCEED 20 MPH BETWEEN MP 9 AND MP 10 BETWEEN CLEAR CREEK AND BROOMFIELD DUE TO MEN AND EQUIPMENT CROSSING OVER MT SOUND BELL AND WHISTLE FREELY WITHIN THESE LIMITS

OUTBOUND MT BETWEEN MP 2.5 AND MP 3.4 BETWEEN JERSEY CUT OFF AND UTAH JCT HAS BEEN REMOVED NORMAL POSITION FOR SWITCH AT 48TH AVENUE ON OUTBOUND IS LINED AND LOCKED FOR CROSSOVER NORMAL POSITION FOR SWITCH ON INBOUND IS LINED AND LOCKED FOR INBOUND

AT BROOMFIELD OCCUPIED OUTFIT CARS ON HOUSE TRACK MUST NOT BE COUPLED INTO OR MOVED

LOOK OUT FOR TIES AND TRACK MATERIAL ALONG MT AND SIDINGS BETWEEN BROOMFIELD AND NORFOLK

AT LONGMONT PURE GAS SPUR OUT OF SERVICE 200 FEET WEST OF SWITCH
AT LONGMONT IN EAST YARD BROKEN RAIL 4 CAR LENGTHS EAST OF WEST SWITCH OF NO 2 TRACK

AT BERTHOUD SIDING BLOCKED WITH CARS

AT CAMPION HOUSE TRACK OUT OF SERVICE AND SWITCH SPIKED

AT LOVELAND HOUSE TRACK OUT OF SERVICE SWITCH IS SPIKED
GW INTERCHANGE TRACK OUT OF SERVICE SWITCHES SPIKED
AND BN 410469 ON GW TRANSFER MUST NOT BE MOVED OR COUPLED INTO

AT NORFOLK HOUSE TRACK OUT OF SERVICE AND SWITCHES ARE LINED AND SPIKED FOR SIDING

LOOK OUT FOR SCRAP AND TRACK MATERIAL BETWEEN MP 119.35 AND MP 119.5 BETWEEN SPEER AND FEDERAL

AT CHEYENNE ROCK TRACK OUT OF SERVICE

JWH

702 pm

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X01 P39 P39 208742R003
O.T.H. K141180 ** VIA C@@ - FILE @@ **
K141180 0020 1618 08/02/85 U320
****TASK ZZ G120724 G120724 JWH N456 ZZ

BN RAILROAD TRACK WARRANT CONTROL RESTRICTED TRACK CONDITIONS

RTC NO 635 AUG 2 1985

| | | | |
|---|---|---|---|
| TO: | C&E WESTWARD TRAINS | AT | 31ST STREET YARD |
| | C&E EASTWARD TRAINS | AT | CHEYENNE |
| | C&E TRAINS ORIG | AT | FT COLLINS |
| | C&E TRAINS ORIG | AT | LONGMONT |

DO NOT EXCEED

10 MPH BETWEEN MP 16.5 AND MP 17 BETWEEN BROOMFIELD AND BOULDER
TRACK FLAGS NOT DISPLAYED

10 MPH BETWEEN MP 44 AND MP 45 BETWEEN LONGMONT AND HIGHLAND

JWH

509 pm

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# TRAIN ORDER No. 28

BURLINGTON NORTHERN RAILROAD

| LOCATION | DATE |
|---|---|
| LONGMONT | AUG 2 1985 |
| TO C&E EXTRA 6575 EAST | |
| TO | |
| TO | |
| TO | |
| TO | |

EXTRA 6575 EAST HAS RIGHT OVER EXTRA 6311 WEST

LONGMONT TO CLEAR CREEK

EXTRA 6575 EAST REGISTER AT CLEAR CREEK

ON ORDER NO 28 OF AUG 2

EXTRA 6311 WEST MAY CHECK REGISTER AT CLEAR CREEK

AGAINST EXTRA 6575 EAST ON ORDER NO 28 OF AUG 2

JWH

| TIME COMPLETED | OPERATOR |
|---|---|
| 507 pm | |

FORM 16108 1-82 READ ALL TRAIN ORDERS PROMPTLY- DISCUSS, UNDERSTAND AND COMPLY WITH THEM U.S.A.

BEST COPY AVAILABLE

**TRAIN ORDER No. 39**

BURLINGTON NORTHERN RAILROAD

| LOCATION | DATE |
|---|---|
| LONGMONT | AUG 2 1985 |
| TO C&F EXTRA 6575 EAST | |
| TO | |
| TO | |
| TO | |
| TO | |

EXTRA 6575 EAST HAS RIGHT OVER EXTRA 7036 WEST

LONGMONT TO CLEAR CREEK

EXTRA 7036 WEST MAY CHECK REGISTER AT CLEAR CREEK

AGAINST EXTRA 6575 EAST ON ORDER NO 28 OF AUG 2

JWH

| TIME COMPLETED | OPERATOR |
|---|---|
| 559 pm | |

FORM 15108 1-82 READ ALL TRAIN ORDERS PROMPTLY- DISCUSS, UNDERSTAND AND COMPLY WITH THEM U.S.A.

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# TRAIN ORDER No. 44

BURLINGTON NORTHERN RAILROAD

| LOCATION LONGMONT | DATE AUG 2 1985 |
|---|---|
| TO C&E ENG 6575 | |
| TO | |
| TO | |
| TO | |
| TO | |

ENG 6575 RUN EXTRA LONGMONT TO CLEAR CREEK

AND RETURN TO LONGMONT

JWH

| TIME COMPLETED 613p | OPERATOR |
|---|---|

DRM 15108 1-82 READ ALL TRAIN ORDERS PROMPTLY- DISCUSS, UNDERSTAND AND COMPLY WITH THEM U.S.A.

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## APPENDIX D

## TRAIN ORDERS EXTRA 6311 WEST

308 345-2850
or 3006

CLEARANCE

BURLINGTON NORTHERN RAILROAD

| 31st St Yard | Aug 2 | 19 85 |
|---|---|---|
| STATION | DATE | |

TO: C&E Extra 6311 West

Clearance No. _____ TO _____

I have 7 orders for your Train

| | | | | | | |
|---|---|---|---|---|---|---|
| No. | 631 | 635 | 636 | 28 | 45 | 46 |
| No. | 47 | | | | | |
| No. | | | | | | |
| No. | | | | | | |
| No. | | | | | | |

| To be filled in when spacing trains Do Not leave before M | TIME OK'D 627 P M. |
|---|---|

JWH
CHIEF DISPATCHER

Ettle
OPERATOR

FOR TIMESLIP INFORMATION ONLY
YOUR COMPASS TRAIN NO: 297
(This number must appear on your timeslip)

FORM 15215 8-79 (OVER)

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X04 P08 P08 @22804B003V ** WASHINGTON
O.T.H. K220977 ** VIA C@@ - FILE @@ **
K220977 0020 1700 08/01/85 U294
( *TASK-ZZ-G120724- G120724- JWH N390 ZZ-

Taken from A. Lynn 8/1 pm

BN RAILROAD TRACK WARRANT CONTROL RESTRICTED TRACK CONDITIONS

RTC NO 631 AUG-1 1985

TO: C&E WESTWARD TRAINS AT 31ST ST YARD
C&E EASTWARD TRAINS AT CHEYENNE
C&E TRAINS ORIG AT FT COLLINS
C&E TRAINS ORIG AT LONGMONT

FROM 601 AM UNTIL 601 PM MONDAY THROUGH FRIDAY DO NOT EXCEED 20 MPH BETWEEN MP 9 AND MP 10 BETWEEN CLEAR CREEK AND BROOMFIELD DUE TO MEN AND EQUIPMENT CROSSING OVER MT SOUND BELL AND WHISTLE FREELY WITHIN THESE LIMITS

OUTBOUND MT BETWEEN MP 2.5 AND MP 3.4 BETWEEN JERSEY CUT OFF AND UTAH JCT HAS BEEN REMOVED NORMAL POSITION FOR SWITCH AT 48TH AVENUE ON OUTBOUND IS LINED AND LOCKED FOR CROSSOVER NORMAL POSITION FOR SWITCH ON INBOUND IS LINED AND LOCKED FOR INBOUND

AT BROOMFIELD OCCUPIED OUTFIT CARS ON HOUSE TRACK MUST NOT BE COUPLED INTO OR MOVED

LOOK OUT FOR TIES AND TRACK MATERIAL ALONG MT AND SIDINGS BETWEEN BROOMFIELD AND NORFOLK

AT LONGMONT PURE GAS SPUR OUT OF SERVICE 200 FEET WEST OF SWITCH
AT LONGMONT IN EAST YARD BROKEN RAIL 4 CAR LENGTHS EAST OF WEST SWITCH OF NO 2 TRACK

AT BERTHOUD SIDING BLOCKED WITH CARS

AT CAMPION HOUSE TRACK OUT OF SERVICE AND SWITCH SPIKED

AT LOVELAND HOUSE TRACK OUT OF SERVICE SWITCH IS SPIKED
GW INTERCHANGE TRACK OUT OF SERVICE SWITCHES SPIKED
AND BN 410469 ON GW TRANSFER MUST NOT BE MOVED OR COUPLED INTO

AT NORFOLK HOUSE TRACK OUT OF SERVICE AND SWITCHES ARE LINED AND SPIKED FOR SIDING

LOOK OUT FOR SCRAP AND TRACK MATERIAL BETWEEN MP 119.35 AND MP 119.5 BETWEEN SPEER AND FEDERAL

AT CHEYENNE ROCK TRACK OUT OF SERVICE

JWH
647PM

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X02 P06 P08 2086428003
T I [illegible]K220977 ** VIA C@@ - FILE @@ **
K220977 0020 1618 08/02/85 U065
*****TASK ZZ G120724 G120724 JWH N456 ZZ

BN RAILROAD TRACK WARRANT CONTROL RESTRICTED TRACK CONDITIONS

RIC NO 635 AUG 2 1985

| | | | |
|---|---|---|---|
| TO: | C&E WESTWARD TRAINS | AT | 31ST STREET YARD |
| | C&E EASTWARD TRAINS | AT | CHEYENNE |
| | C&E TRAINS ORIG | AT | FT COLLINS |
| | C&E TRAINS ORIG | AT | LONGMONT |

DO NOT EXCEED

10 MPH BETWEEN MP 16.5 AND MP 17 BETWEEN BROOMFIELD AND BOULDER
TRACK FLAGS NOT DISPLAYED

0 MPH BETWEEN MP 44 AND MP 45 BETWEEN LONGMONT AND HIGHLAND

JWH
507 PM

X02 P06 P06 585934R003
D.T.H. K220977 ** VIA C@@ - FILE @@ **
K220977 0020 1656 08/02/85 U088
****TASK ZZ G120724 G120724 JWH N472 ZZ

BN RAILROAD TRACK WARRANT CONTROL RESTRICTED TRACK CONDITIONS

RTC NO 636 AUG 2 1985

| | | | |
|---|---|---|---|
| TO: | C&E WESTWARD TRAINS | AT | 31ST STREET YARD |
| | C&E EASTWARD TRAINS | AT | CHEYENNE |
| | C&E WESTWARD TRAINS | AT | CHEYENNE |
| | C&E TRAINS ORIG | AT | WHEATLAND |
| | C&E EASTWARD TRAINS | AT | GUERNSEY |

AT CHEYENNE FOLLOWING TRACKAGE OUT OF SERVICE DUE TO WASHOUTS
WEST LEG OF WYE
TETON LUMBER
CHEYENNE BEVERAGE
MISSLE SWITCH
ROUNDHOUSE LEAD
6 TRACK
5 TRACK
4 TRACK AND MT IN SERVICE

AT CHEYENNE WATCH OUT FOR UNEVEN FOOTING AND TRIPPING HAZARDS
DUE TO HIGH WATER

JWH
623pm

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TRAIN ORDER NO. 28

BURLINGTON NORTHERN

DATE AUG 2 1985

X OPER

TIME

LOCATION 31ST ST YARD

TO

TO C&E EXTRA 6311 WEST

TO

TO

TO

EXTRA 6575 EAST HAS RIGHT OVER EXTRA 6311 WEST LONGMONT

TO CLEAR CREEK

EXTRA 6575 EAST REGISTER AT CLEAR CREEK ON ORDER NO 28

OF AUG 2

EXTRA 6311 WEST MAY CHECK REGISTER AT CLEAR CREEK AGAINST EXTRA

6575 EAST ON ORDER NO 28 OF AUG 2

JWH

TIME COMPLETED 505 PM

OPERATOR ETTLE

FORM 6510F 1-76 READ TRAIN ORDERS THOROUGHLY BE SURE YOU UNDERSTAND AND COMPLY WITH THEM

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# TRAIN ORDER NO. 45

BURLINGTON NORTHERN

DATE AUG 2 1985

X OPR

TIME

| | |
|---|---|
| LOCATION | 31ST ST YARD |
| TO | |
| TO | C&E EXTRA 6311 WEST |
| TO | |
| TO | |
| TO | |

EXTRA 6311 WEST TAKE SIDING MEET

EXTRA 8060 EAST AT NORTH YARD

JWH

| TIME COMPLETED | OPERATOR |
|---|---|
| 619 PM | ETTLE |

FORM L5108 1 76 1 READ TRAIN ORDERS PROMPTLY - DISCUSS, UNDERSTAND AND COMPLY WITH THEM

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APPENDIX D

TRAIN ORDER NO. 46

BURLINGTON NORTHERN

DATE AUG 2 1985

X OPR.

TIME

LOCATION 31ST ST YARD

TO

TO C&E EXTRA 6311 WEST

TO

TO

TO

EXTRA 6311 WEST TAKE SIDING MEET
EXTRA 8160 EAST AT NORTH YARD

JWH

TIME COMPLETED 622 PM

OPERATOR ETTLE

FORM 15108 1 76 READ TRAIN ORDERS PROMPTLY - DISCUSS, UNDERSTAND AND COMPLY WITH THEM

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TRAIN ORDER NO. 47

BURLINGTON NORTHERN

DATE AUG 2 1985

X

TIME

LOCATION 31ST ST YARD

TO

TO C&E ENG 6311

TO

TO

TO

ENG 6311 RUN EXTRA UTAH JCT TO CHEYENNE

JWH

TIME COMPLETED 624 PM

ETTLE

FORM 15106 1-76 READ TRAIN ORDERS PROMPTLY - DISCUSS, UNDERSTAND AND COMPLY WITH THEM

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## APPENDIX E

## REVERSE SIDE OF CLEARANCE CARD USED FOR TRAIN REGISTER INFORMATION

**TRAIN REGISTER CHECK**

At _____

Time _____ M. Date _____ 19___

| TRAIN | TIME | | Signals Registered |
|---|---|---|---|
| | Arrived | Departed | |
| | | | |
| | | | |
| | | | |
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Conductor _____

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## APPENDIX F

## TRACK WARRANT CONTROL AUTHORITY

### TRACK WARRANT CONTROL AUTHORITY

TRACK WARRANT NO. _____ _____, 19____

TO: _____ AT: _____

(1) ☐ TRACK WARRANT NO. _____ IS VOID.

THIS IS AUTHORITY TO:

(2) ☐ PROCEED ONLY AS AUTHORIZED BY CTC SIGNAL INDICATION. or Train order

(3) ☐ PROCEED FROM _____ TO _____

(4) ☐ WORK BETWEEN _____ AND _____

SUBJECT TO THE FOLLOWING SPECIFIC INSTRUCTIONS:

(5) ☐ NOT IN EFFECT UNTIL AFTER ARRIVAL OF _____ AT _____

(6) ☐ NOT IN EFFECT UNTIL AFTER DEPARTURE OF _____ AT _____

(7) ☐ NOT IN EFFECT UNTIL _____M.

(8) ☐ PROTECTION AS PRESCRIBED BY RULE 99 NOT REQUIRED.

(9) ☐ CLEAR MAIN TRACK AT LAST NAMED POINT.

(10) ☐ HOLD MAIN TRACK AT LAST NAMED POINT.

(11) ☐ BETWEEN _____ AND _____ MAKE ALL MOVEMENTS AT RESTRICTED SPEED AND STOP SHORT OF MEN OR MACHINES FOULING TRACK.

(12) ☐ BETWEEN _____ AND _____ MAKE ALL MOVEMENTS AT RESTRICTED SPEED. LIMITS ARE OCCUPIED BY MORE THAN ONE TRAIN OR ENGINE.

(13) ☐ AUTHORITY EXPIRES AT _____M.

(14) ☐ DO NOT EXCEED

_____ MPH BETWEEN _____ AND _____

_____ MPH BETWEEN _____ AND _____

(15) ☐ OTHER SPECIFIC INSTRUCTIONS _____

Obtain clearance at N

RTC(s) NO _____ NO. _____ NO. _____ NO. _____ NO. _____

OK'd AT _____M. DISPATCHER _____

RELAYED BY _____ COPIED BY _____

REPORTED CLEAR AT _____M. BY _____

(Mark "X" in box for each applicable item.)

4-84

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